

U  
RV1

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

RESIDUAL VALUE FORECASTS <sup>4/</sup>  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES  
APRIL 1978

UPS  
RV1

## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Providing detailed forecasts of computer and communications trends for 1978-1983.
- Analyze the probable moves in operating systems, networks and mass storage.
- Contains analyses and long-term plans of financial ratio data.
- In-depth analyses of the managerial, and personnel
- Successful approaches to managing clients.
- Seminars held at a convenient time and place according to client needs.
- Workshops with research staff on an as-needed basis.
- Specific presentations to client groups.
- Research in computers, communications, and management.
- A steering committee consisting of representatives from the client organization, INPUT, and other analysts.
- Based on the judgement of INPUT's staff.
- Professional staff supporting this program have 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

RESEARCH MANAGEMENT  
communication

INPUT LIBRARY  
CIRCULATION ONLY

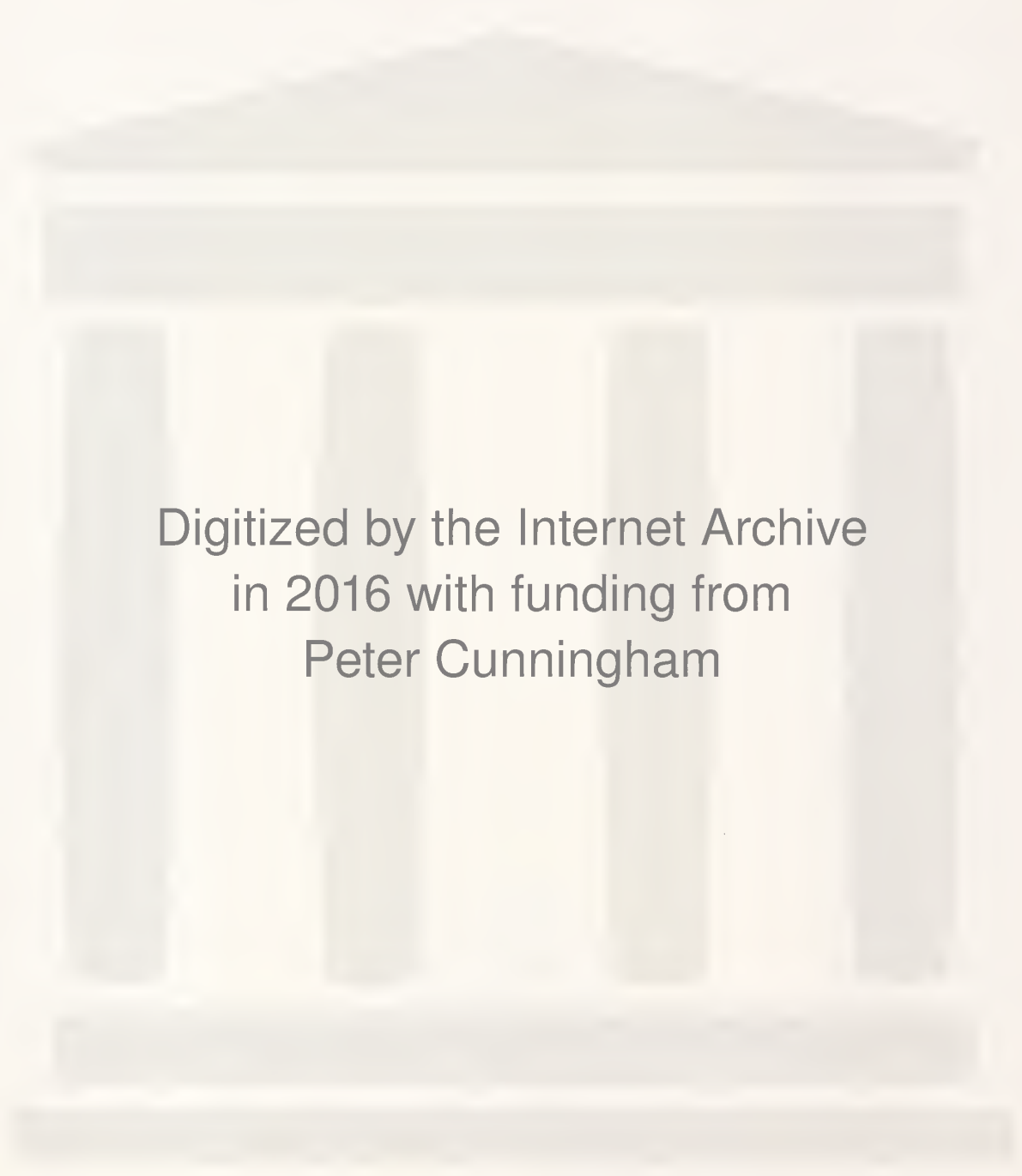
For further information on this report or program, please call or write:

Edward I. Metz, Principal  
INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ 07662  
(201) 368-9471

RESIDUAL VALUE FORECASTS 4/  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

APRIL 1978

INPUT LIBRARY



Digitized by the Internet Archive  
in 2016 with funding from  
Peter Cunningham



RESIDUAL VALUE FORECASTS FOR LARGE IBM  
AND PLUG COMPATIBLE MAINFRAMES

TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION	I
II RECENT DEVELOPMENTS IN THE LARGE IBM CPU MARKET	3
A. Market Activity (June 1977 - March 1978)	3
B. Vendor Activities (June 1977 - March 1978)	4
III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES	8
IV FUTURE RESIDUAL VALUES OF IBM AND AMDAHL PROCESSORS	13
APPENDICES	
A: DETERMINANTS OF RESIDUAL VALUE	23
B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS	26
C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS	30



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES

## LIST OF EXHIBITS

	<u>Page</u>
II -1 Comparison Of Large IBM And Amdahl Processors	5
III -1 Distributed Data Processing Configuration	10
IV -1 Actual And Projected Values For IBM 370/158 Processor	14
-2 Actual And Projected Values For IBM 370/168 Processor	15
-3 Projected Values For IBM 303X Series Processors	17
-4 Projected Values For Amdahl 470 V/5 And V/6 Processors	19
-5 Projected Values For Amdahl 470 V/7 Processor	20
B -1 Variables Affecting Values Of Used IBM Computers	27
C -1 IBM Price Changes For 370/158 And 370/168 Processors	33
-2 Monthly Decline In Purchase Price Due To Purchase Option Accruals When Renting From IBM Under Monthly Rental Charge (MRC) Plan	34



## I INTRODUCTION





## I INTRODUCTION

- In June 1977, INPUT published "Plug Compatible Mainframes; The New Hardware Economics," which examined the market for large IBM and IBM plug compatible CPUs - new product announcements, price/performance changes, and likely future developments. The report included projections of residual values through 1981.
- This report is an update to that 1977 study and includes residual value projections for the IBM 370/158, 370/168, 3031, 3032, and 3033 and for the Amdahl 470 V/5, V/6, and V/7 CPUs through 1983.
- This report includes (as will future reports provided in this service) a review of market activity in large IBM CPUs since the last report. This review (Chapter II) also indicates how INPUT projections compare to actual market developments.
- Variables which affect residual values, as analyzed in the June 1977 study, are discussed in the Appendices. Developments since then have altered some earlier assumptions and weighting factors used in calculating values. These developments are also discussed in Chapter II.
- The dominant factors influencing residual values are:
  - Price/performance impact of new product announcements.
  - Price changes by equipment manufacturers on existing equipment.

- Rumor or announcement of significant technology advances (hardware or software).
- Supply/demand factors acting in the market as driven by relative end user saturation levels.

INPUT discusses these issues in Chapter III.

- Residual value projections for each of the CPUs covered by this report are given in Chapter IV. The used computer industry by convention always lists used equipment as a percentage of manufacturer's current list price. The projections graphed in Chapter IV follow this convention. Readers are cautioned to consider price changes which have occurred (and which are noted on the 370/158 and 370/168 graphs) when analyzing their own unique situations. For instance, a two megabyte 370/158 at 84% of the current \$1.46 million list price would bring \$1.23 million - a 59% return on the \$2.1 million price in effect before 4/1/77.
- While this report was in preparation, IBM announced the 3033 multi-processor, as previously forecasted by INPUT. The projected impact on Residual Values of the equipment considered in this report is slight and is included in the analysis.
- This Residual Value report is produced as part of the Planning Service for Computer and Communications Users. Data contained herein will be updated every 6 months. In addition, key issues considered in this report, such as the future of IBM hardware and software, will be subjects of "Vendor Watch" reports. Inquiries and comments on the information presented are requested from clients.

## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU MARKET



## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU MARKET

### A. MARKET ACTIVITY (JUNE 1977 - MARCH 1978)

- There has been very little trading in 370/158 and 370/168 CPUs since June 1977. Very few CPUs have been offered for sale in the market in spite of relatively strong demand and in spite of the fact that over 40 Amdahl CPUs have been installed during this time frame.
- Listing prices for 370/158 and 370/168 CPUs remained fairly stable throughout the period at 83-85% of IBM's current list prices. INPUT had projected a range of 60-85% by first quarter 1978.
- The price levels have been maintained due to this lack of availability of 370/158 and 370/168 CPUs for trading. They simply have not been replaced:
  - The current strong demand for 370/158 and 370/168 CPUs reflects a low degree of excess CPU capacity at the user level. There is a tendency to add rather than replace when increasing CPU capacity.
  - INPUT's 6/77 projections assumed Amdahl installations would displace some 370/158 and 370/168 CPUs - this has not happened.
  - INPUT also assumed IBM would bring 303X series CPUs into the market more rapidly than current delivery schedules indicate.

## B. VENDOR ACTIVITIES (JUNE 1977 - MARCH 1978)

- IBM announced the 3031 and 3032 processors in October 1977. INPUT, in the "New Hardware Economics," had predicted a 3032 (power = 370/168 - 3, price = \$2 million) and 3031 (power = 370/158 - 3, price = \$1 million) would be announced in 1977:
  - The 3031 and 3032, as expected, are similar to the 370/158-3 and 370/168-3. The memory cycle times and machine cycle times are identical. Exhibit II-1 provides a comparison of the IBM 370/158, 370/168, 303X series and Amdahl CPUs.
  - The 3032 is packaged differently from the 370/168 with inboard channels and with features such as high speed multiply and control store expansion incorporated into the base price. The integrated storage control (ISC) feature available on 370/158 and 370/168 CPUs is not available on the 303X (or plug compatible CPUs) - a fact which caused used 3830 disk controller prices to increase. The 3032 is believed to use microcode for some functions hardwired in the 370/168.
  - The 3031 differs from the 370/158-3 in three areas. The buffer (or cache) memory size is large (32K vs. 16K), four way memory interleaving is used, and channel capacity is greater (six channels are standard vs. the 370/158's two standard and three optional channels).
- The 3033 delivery dates associated with "first day orders" were delayed several months as IBM attempted to weed out speculative order positions. IBM developed a new agreement form designed to prevent the sale of CPU delivery positions - a highly lucrative practice for "brokers" who had early 370/138 and 370/148 delivery positions.



## COMPARISON OF LARGE IBM AND AMDAHL PROCESSORS

**NOTES:**

- (1) CPU main memory size = 4 million bytes. Monthly maintenance cost is for 24-hour 7-day coverage.
- (2) The 168-3 uses outboard channels. For comparative purposes, both the standard and optional channel groups were assumed to be one 2870-byte multiplexer channel and five 2880-block multiplexer channels.
- (3) IBM provides a one-year warranty on CPUs (90 days for 168 outboard channels). Amdahl commences maintenance charging on installation acceptance date.

- 5 -

- Delivery dates for the 303X series extend from March 1978 into 1981. Those with late delivery positions are seriously considering other alternatives, such as used 370 CPUs or plug compatibles. The volume of orders for the 3033 (2000-2500) surprised IBM, thereby making it difficult for it to respond to customer demands.
- There are rumors already of the sale of 303X series delivery positions. It remains to be seen how effective IBM can be in policing this area.
- Plug compatible CPU sources are doing better than expected. Amdahl (with 90 installations through 1/1/78) expects to ship at least 120 CPUs in 1978. Intel is well ahead of its projected sales and backlog projections and expects to ship 180 CPUs (30 of the 370/168 equivalent AS/6 CPUs).
- Although other CPU manufacturers have responded to IBM's new price/performance levels so that IBM is not at the "top of the heap," few of them have a significant price/performance advantage relative to IBM.
- IBM's announcement of the 3031 and 3032 and Amdahl's recent price adjustments on the 470 V/5 and 470 V/6-II have resulted in the following price/performance ratios (current 370/158 - 3 = 1):

<u>System</u>	<u>Internal Performance</u>	<u>Price/Performance</u>
370/158-3	1.0	1.0
3031(EF)*	1.2	2.0
370/168-3	2.9	1.3
3032(EF)	3.1	2.2
470 V/5	3.3	2.5
470 V/6-II	5.1	3.1
3033(EF)	5.6	3.0
470 V/7	7.4	3.8

\*Extended Facility feature IBM announced 4/1/77 concurrent with 3033 announcement.

- INPUT, in the "New Hardware Economics," predicted Amdahl would adjust prices as a reaction to the 3032. Those predictions compare to actual announcements as follows:

<u>System</u>	<u>Projected P/P June 1977</u>	<u>Actual Price/Performance March 1978</u>
3032(EF)	1.0	1.0
3033	1.13	1.16
3033(EF)	1.27	1.36
470 V/6-11	1.49	1.4
470 V/7	1.66	1.7

- IBM's major current problem is delivery. Many users delayed actions to increase capacity while waiting to see what developed and now find they cannot tolerate long delivery schedules for 303X systems..
- In summary, since June 1977, the large CPU marketplace has stabilized:
  - Alternatives are now better understood.
  - Delivery schedules for the 303X processors are known and deliveries have begun.
  - CPU suppliers other than IBM have reacted with new product and/or pricing changes.
  - Used 370/158 and 370/168 CPUs have been very scarce.



### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES



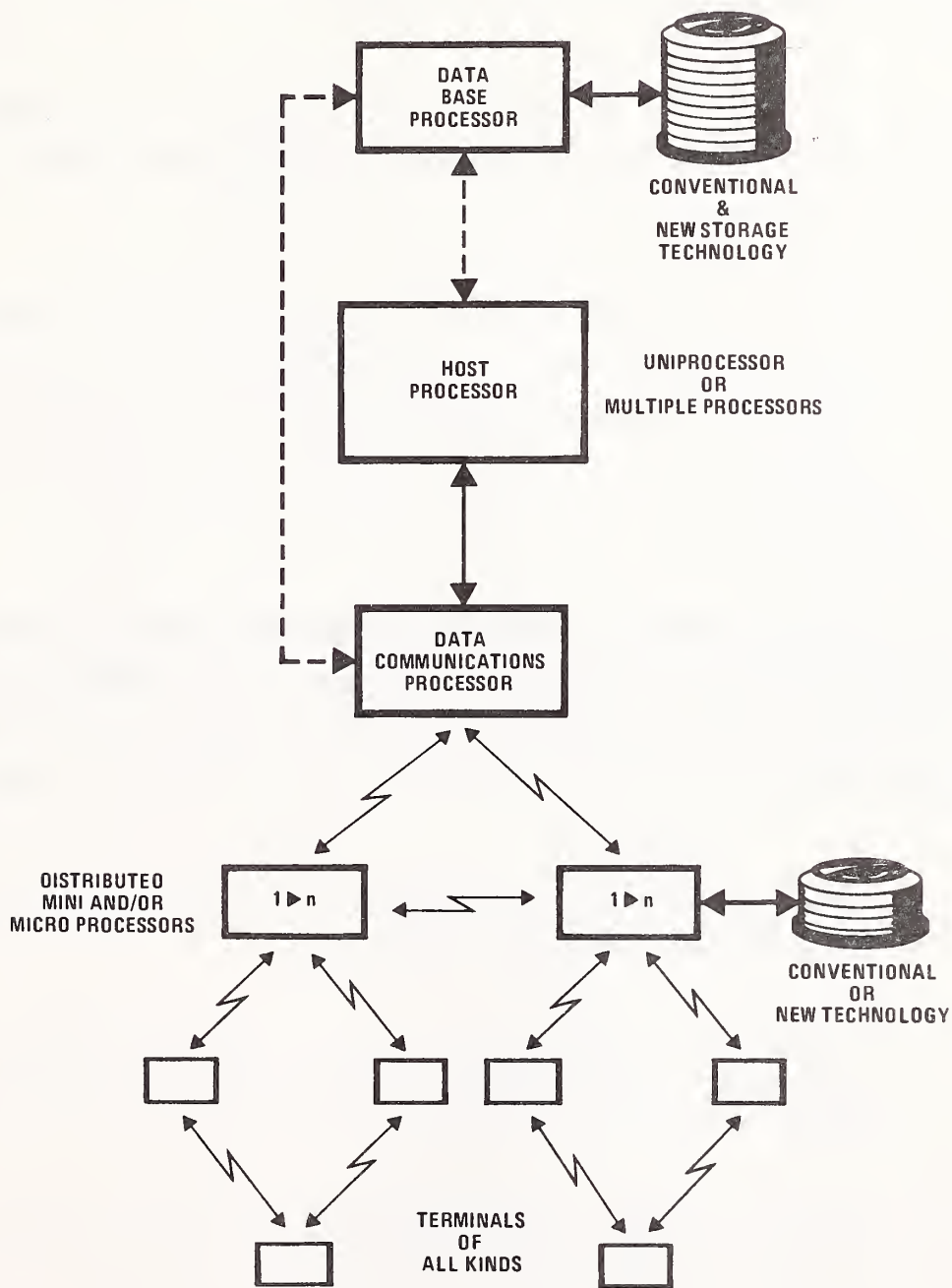


### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES

- The price/performance ratios given in the previous chapter are not expected to significantly change until a new product line is introduced by IBM in the early 1980s. As an example, ITEL's recently announced AS/6 CPU is competitive with the 370/168 and 3032 but will be priced to give it the price/performance characteristics required by market conditions. It will not be priced so as to upset the current balance in the marketplace.
- There has been a development in CPU price/performance and architecture during the last year which could affect large scale uniprocessor future values:
  - Tandem Computers shipped a ten processor system valued at approximately \$2 million.
  - While performance has not yet been fully evaluated, internal processor speeds, channel capacity and memory all indicate it should have potential processing power equivalent to large systems now available.
  - Actual throughput in an on-line environment may be very impressive due to the elimination of the "oppressive" software overhead associated with IBM operating systems.
  - Equally important are considerations of reliability and security which are inherent in the combined hardware/software design.

- The modular approach from two processors up to sixteen permits the construction of systems with a very wide range of performance. This circumvents the "stepping-stone" architecture which has prevailed in the industry since the announcement of System/360. True multi-processing appears to have arrived.
- Although the Tandem approach is impressive in concept, INPUT does not believe it will materially affect large IBM CPU residuals in the time frame of this report. Their incompatibility with current IBM software and limited production capacity will inhibit market impact.
- Another potential major threat to large scale 370 systems comes from distributed processing. Exhibit III-1 depicts the situation graphically.
  - It is estimated that by moving processing functions out from the large scale hosts that off-loading factors of 50% to 70% are possible. Thirty percent is probably achievable today by improved editing of input data before transmission to the host.
  - Recently proposals for "backend" data base computers have appeared which are designed to off-load the overhead associated with current data base systems ( primarily IMS). It has been estimated that 50% of all commercial data processing could be handled by data base computers. They are expected to be available in the 1980s and could significantly extend the useful life of existing large processors.
- IBM systems software overhead consumes enormous processing capacity and will perpetuate the need for large scale processors unless drastic changes are made in software system designs.
  - Operating systems have evolved to the point where a host computer burdened with MVS/IMS/VTAM cannot readily support IBM's SNA strategy.

EXHIBIT III-1  
DISTRIBUTED DATA PROCESSING CONFIGURATION



- IMS, itself, has significant performance problems and cannot function effectively with large data bases and/or high transaction levels. Executing between 70,000 and 120,000 instructions per transaction can absorb all of the processing power of the largest announced systems and still not give satisfactory performance.
- The simple fact is that IBM systems software was designed for another era (the "batch" era) and it has grown to the point where it is a primary reason for escalating capacity requirements.
- IBM does not plan to radically change its systems software. Internal improvements will be made and may be separately priced - such as the Extended Facility feature announced with the 3033 CPU. The decreasing cost of hardware will be expected to absorb software inefficiencies.
- IBM's strategy since the introduction of computers into commercial data processing has been to control the acceptance and application of advanced technology. It has been extremely effective in this regard until recently. The period between now and the mid 1980s will present a major challenge to IBM:
  - The threat from plug compatible mainframes can probably be contained and is currently its primary objective.
  - Distributed processing will impact currently installed mainframes before IBM is prepared to exploit this trend for its own purposes.
  - Systems software and especially IMS will be improved. This will probably be done with a combination of firmware and software as discussed in detail in the "New Hardware Economics" report.
  - IBM will introduce new technology in the early 1980s (announcement probably in 1981/82 with delivery impact in 1983/84) which supports faster channel transfer rates and increased addressing capability (probably 39 bit addressing which provides 512 billion unit addressing



capability). Such technology is needed to support IBM objectives in hierarchical storage, communications, and equipment security/reliability/serviceability. The price/performance improvements of this new technology will be comparable to the 303X series announcements (i.e., 2-3:1). INPUT does not anticipate significant price changes on existing announced IBM or Amdahl CPUs until this new technology introduction.

- The long-term outlook for the computer industry appears very healthy:
  - Excess capacity at the user level is at relatively low levels.
  - Declining computer hardware costs and rising human labor costs cause transfer of functions to computers.
  - Use of computers in the service sector is increasing rapidly.
  - It appears that worldwide demand will exceed supply for the foreseeable future.





IV FUTURE RESIDUAL VALUES OF IBM  
AND AMDAHL PROCESSORS



#### IV FUTURE RESIDUAL VALUES OF IBM AND AMDAHL PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the plug compatible mainframe manufacturers.
  - Other mainframe manufacturer actions, both domestic and international.
  - Analysis of other variables affecting residual values, as described in the Appendices.
- The residual value curves in Exhibits IV-1 and IV-2 show actual listing prices for IBM 370/158 and 370/168 processors through 1977, and projected values through 1983.
- From January 1978 to January 1979, relatively few 370/158 and 370/168 CPUs are expected to be replaced by 303X or plug compatible CPUs and thus available for resale. Their residual values are expected to remain fairly high, therefore.
- There will be a fairly rapid decline in residual values of these CPUs in early to mid 1979 as their availability on the market increases.

# EXHIBIT IV-1

## ACTUAL AND PROJECTED VALUES FOR IBM 370/158 PROCESSOR

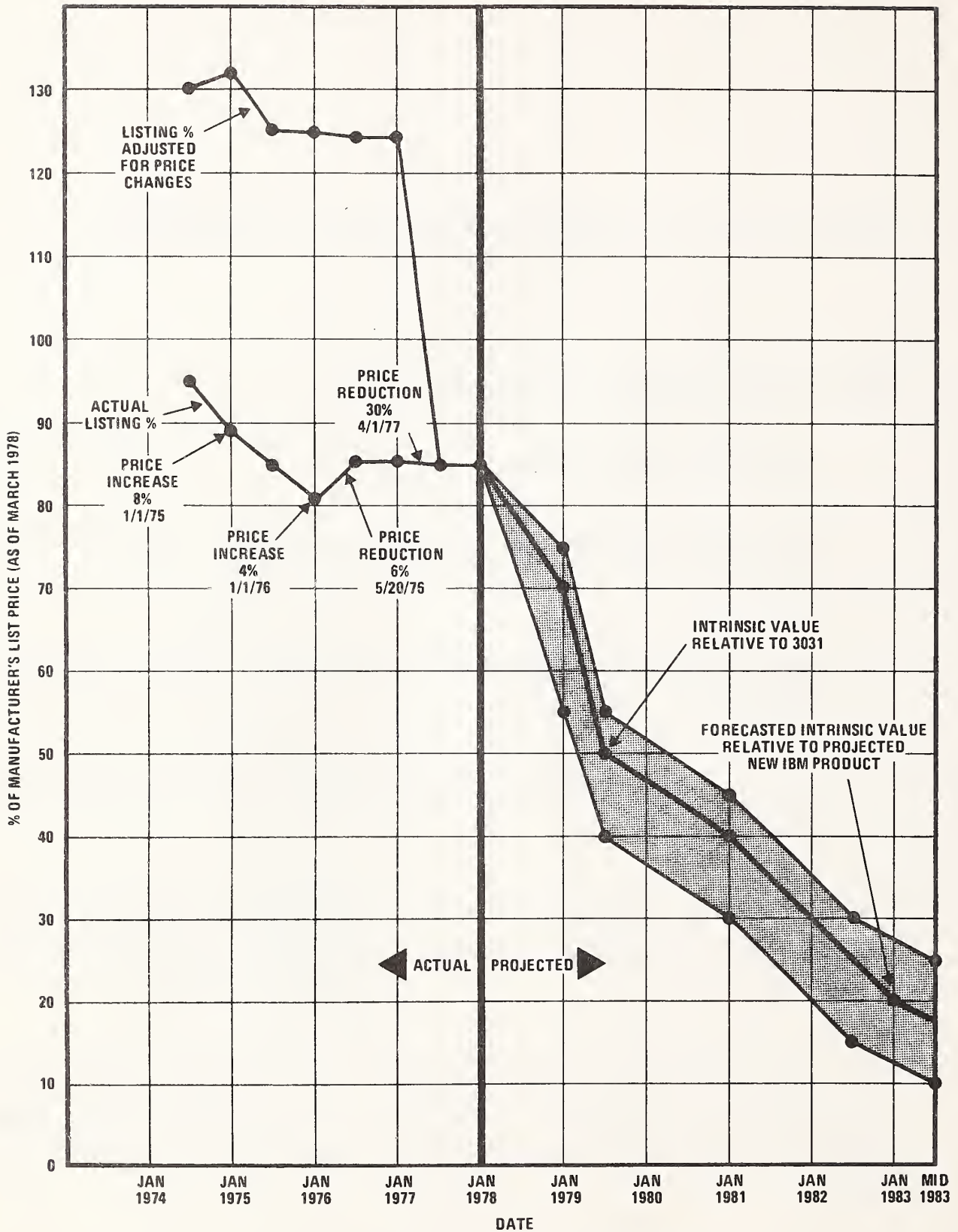


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	75%	52%	45%	35%	28%
EXPECTED	70%	47%	40%	30%	20%
LOW	55%	37%	30%	20%	13%

# EXHIBIT IV-2

## ACTUAL AND PROJECTED VALUES FOR IBM 370/168 PROCESSOR

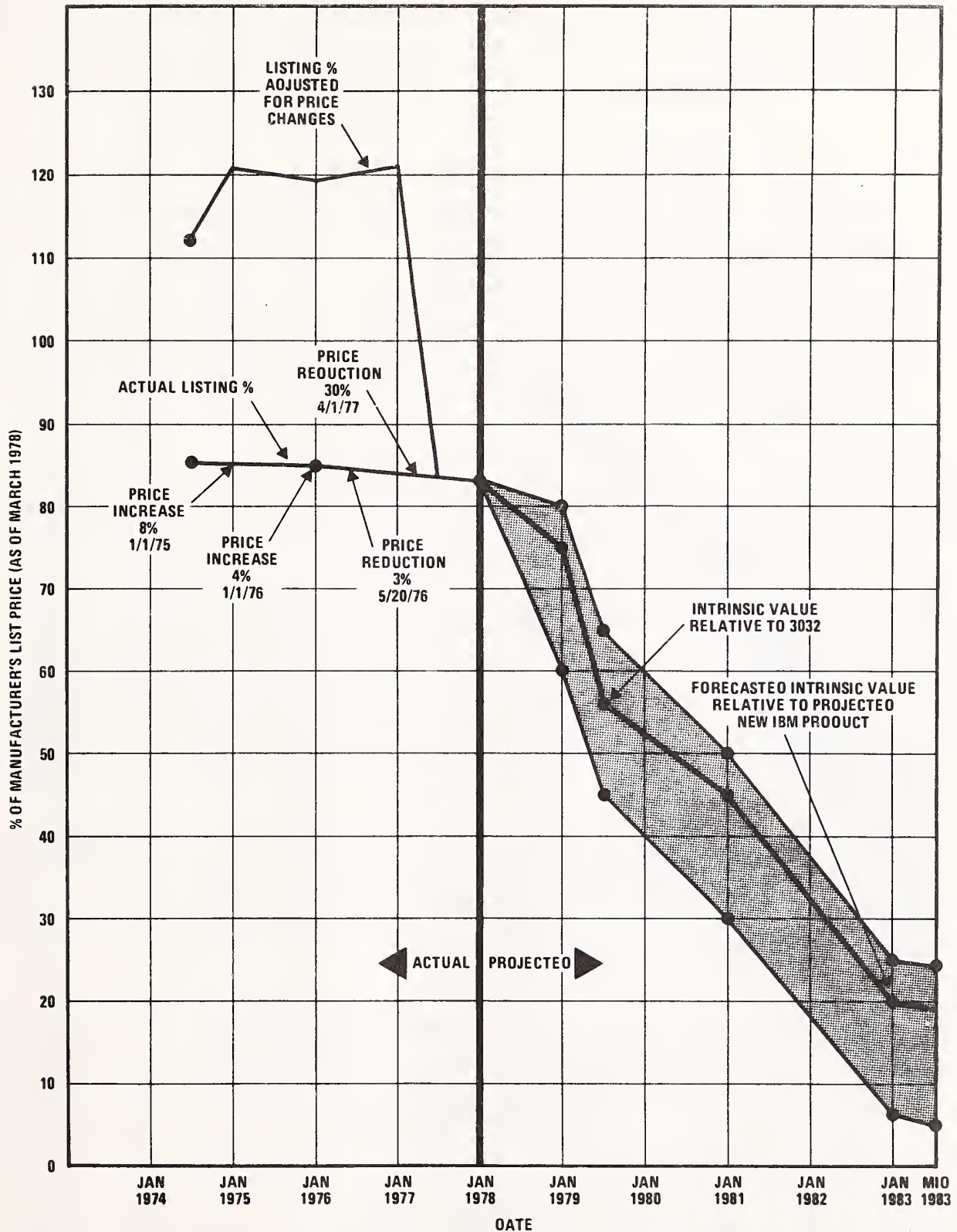


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	80%	60%	50%	38%	25%
EXPECTED	75%	53%	45%	32%	20%
LOW	60%	40%	30%	18%	8%



- INPUT expects 370/158 and 370/168 used CPUs to be selling at near their 303X related intrinsic value by mid 1979. Intrinsic value equals 303X price (3031 price for 158, 3032 price for 168) adjusted for internal performance factors.
- A new IBM CPU product line announcement (or strong rumor thereof) is expected by 1981 which will accelerate the rate of decline of residual values. Delivery impact, or the point in time when used CPUs will sell near their revised intrinsic values, is projected by early 1983. Prior to this announcement (1979-81 time period), the rate of residual value decline is projected to approximate historical patterns for 360 and 370 series CPUs at the midpoint in their product cycles.
- Relative uncertainty concerning these projections is defined by the shaded area above and below the expected value curve.
  - IBM could, as an example, introduce significant enhancements to the 3032 not available to the 370/168 which therefore would degrade the 370/168's intrinsic value. The similarity in architecture between the CPUs makes such developments difficult but certainly not impossible.
  - The width of this band of uncertainty and relative up or downside risk at various points in time varies by CPU. The greater downside risk for the 370/168 when compared to the 370/158 is caused in part by the 370/168's water cooling requirement.
- For the IBM 303X series, from mid 1978 to January 1980 residual values will be higher than equivalent "new" price (considering ITC and warranty) because of demand, as shown in Exhibit IV-3. Transactions in this time period will be few, if any.
- Based on patterns with the 360 and 370 product series, we would expect residual values to then be maintained at equivalent new pricing for approximately 2 to 2½ years. However, INPUT expects the life cycle of the

# EXHIBIT IV-3

## PROJECTED VALUES FOR IBM 303X SERIES PROCESSORS

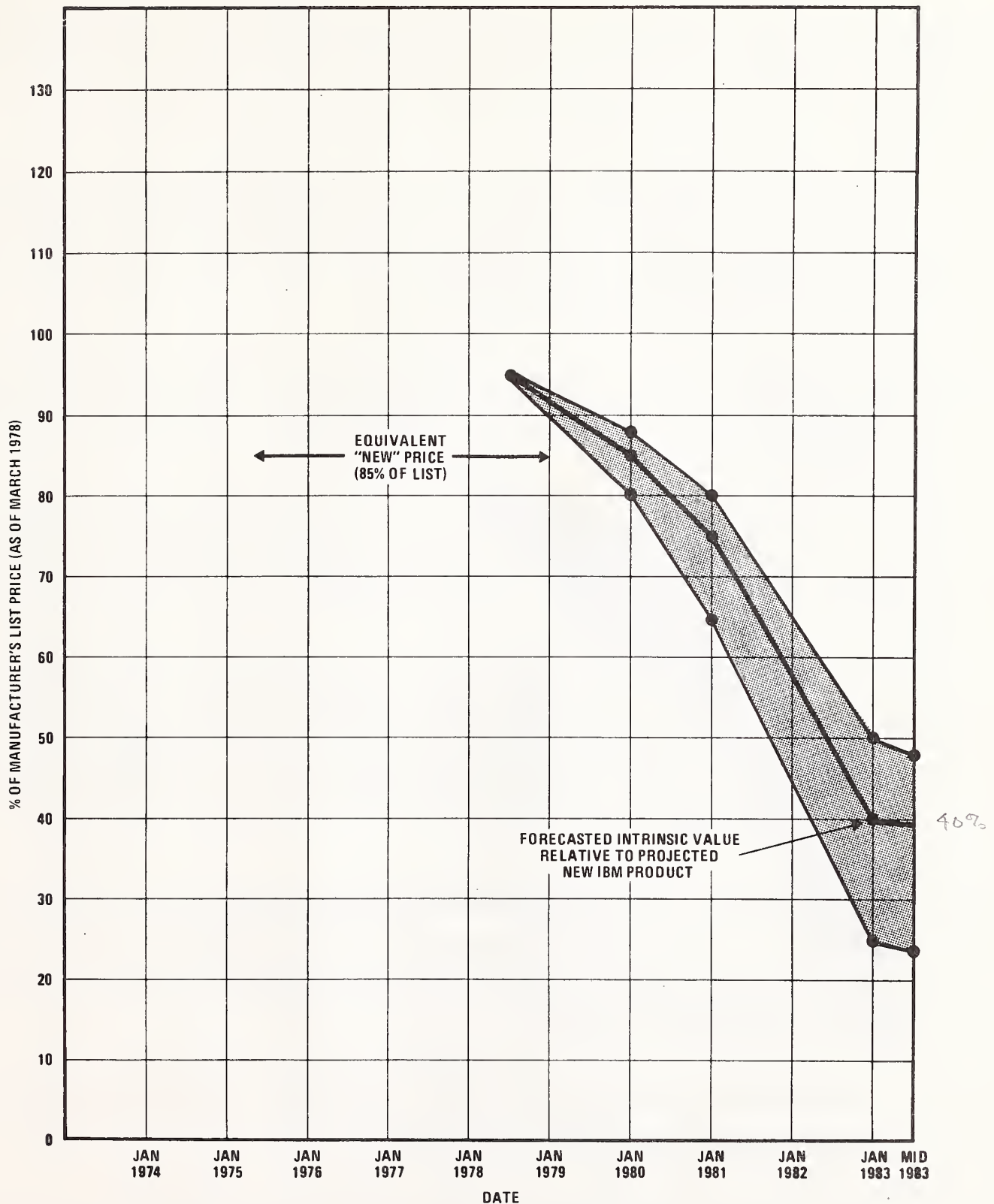


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	93%	88%	80%	65%	50%
EXPECTED	92%	85%	75%	57%	40%
LOW	90%	80%	65%	45%	25%

303X to be shorter than normal since they are only extensions of the 370 series; therefore, we project a declining curve from equivalent new value, the rate of which will accelerate after the projected new product announcement in early 1981.

- The intrinsic value level of 303X CPUs relative to IBM's next product series is projected to be reached in early 1983. (This point is equivalent to the 370/158 and 370/168 "intrinsic value" points in mid 1979 when these CPUs are compared to their 303X equivalents.)
- For Amdahl, and also Intel, plug compatible equipment, the span of uncertainty and downside risk are much greater than for IBM equivalents, as shown in Exhibits IV-4 and IV-5:
  - Only one chart for the 303X series is provided because the price/performance equivalency across the product line is expected to be maintained.
  - Two charts for Amdahl are provided because of the superior price/performance of the 470 V/7 relative to the V/5 and V/6. This results in higher relative residual values for the V/7 compared with the V/5 and V/6.
- Because of much shorter delivery lead times and a more limited market when compared to equivalent IBM equipment, Intel and Amdahl CPUs are not expected to sell above equivalent new values (possible exceptions are Amdahl 470/7 and projected Intel AS/7).
- The impact of the projected 1981 new product series on Amdahl and Intel CPUs will be similar to that shown for IBM CPUs.
- The relatively high downside risk associated with Amdahl processors is mainly the uncertainty regarding Amdahl's ability to retain close compatibility with IBM. INPUT projects that Amdahl is likely to retain this compatibility over the forecast period as reflected in the expected value curve. Other assumptions included in the Amdahl forecasts are:



# EXHIBIT IV-4

## PROJECTED VALUES FOR AMDAHL 470 V/5 AND V/6 PROCESSORS

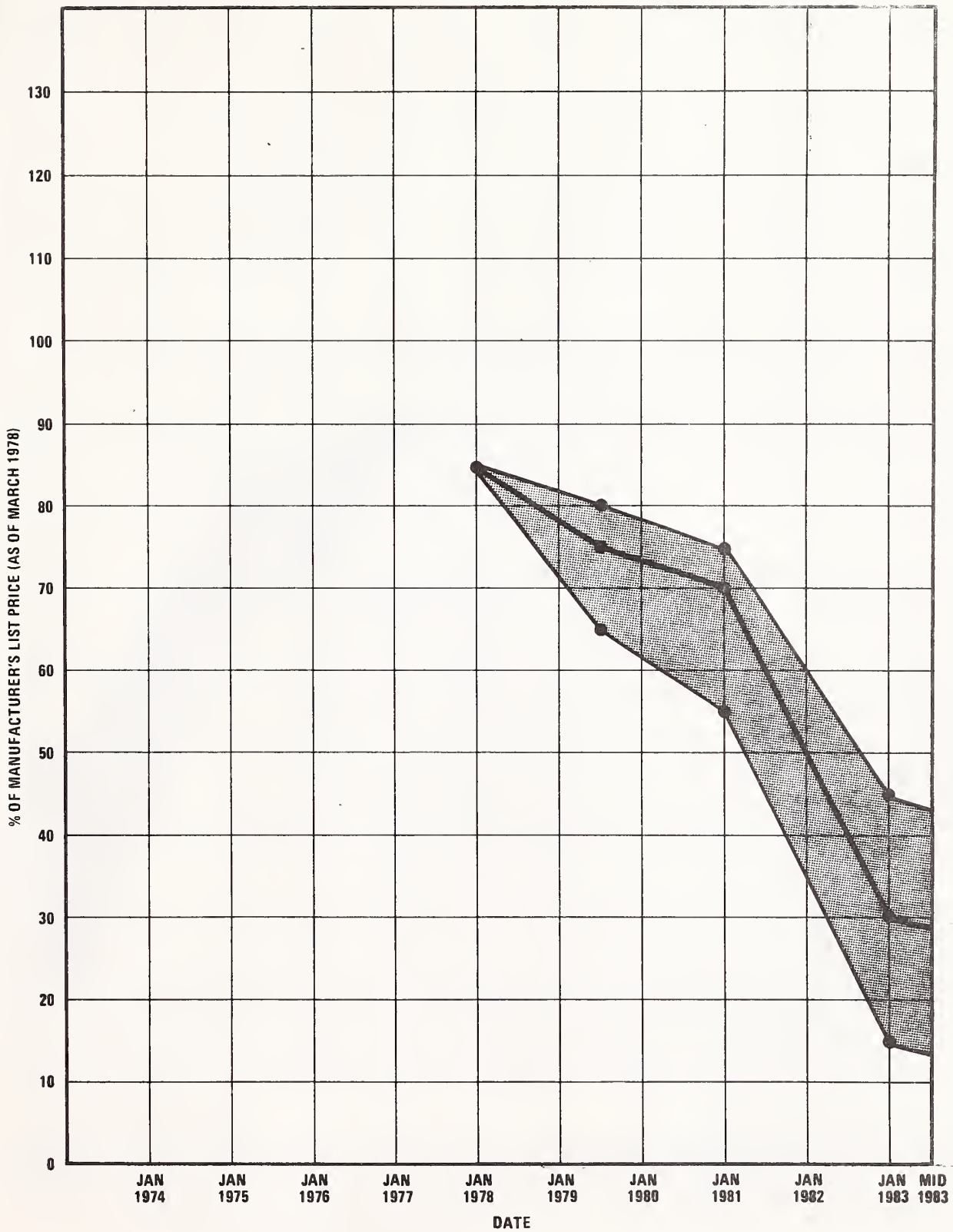


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	82%	78%	75%	60%	45%
EXPECTED	78%	73%	70%	50%	30%
LOW	72%	62%	55%	35%	15%

# EXHIBIT IV-5

## PROJECTED VALUES FOR AMDAHL 470 V/7 PROCESSOR

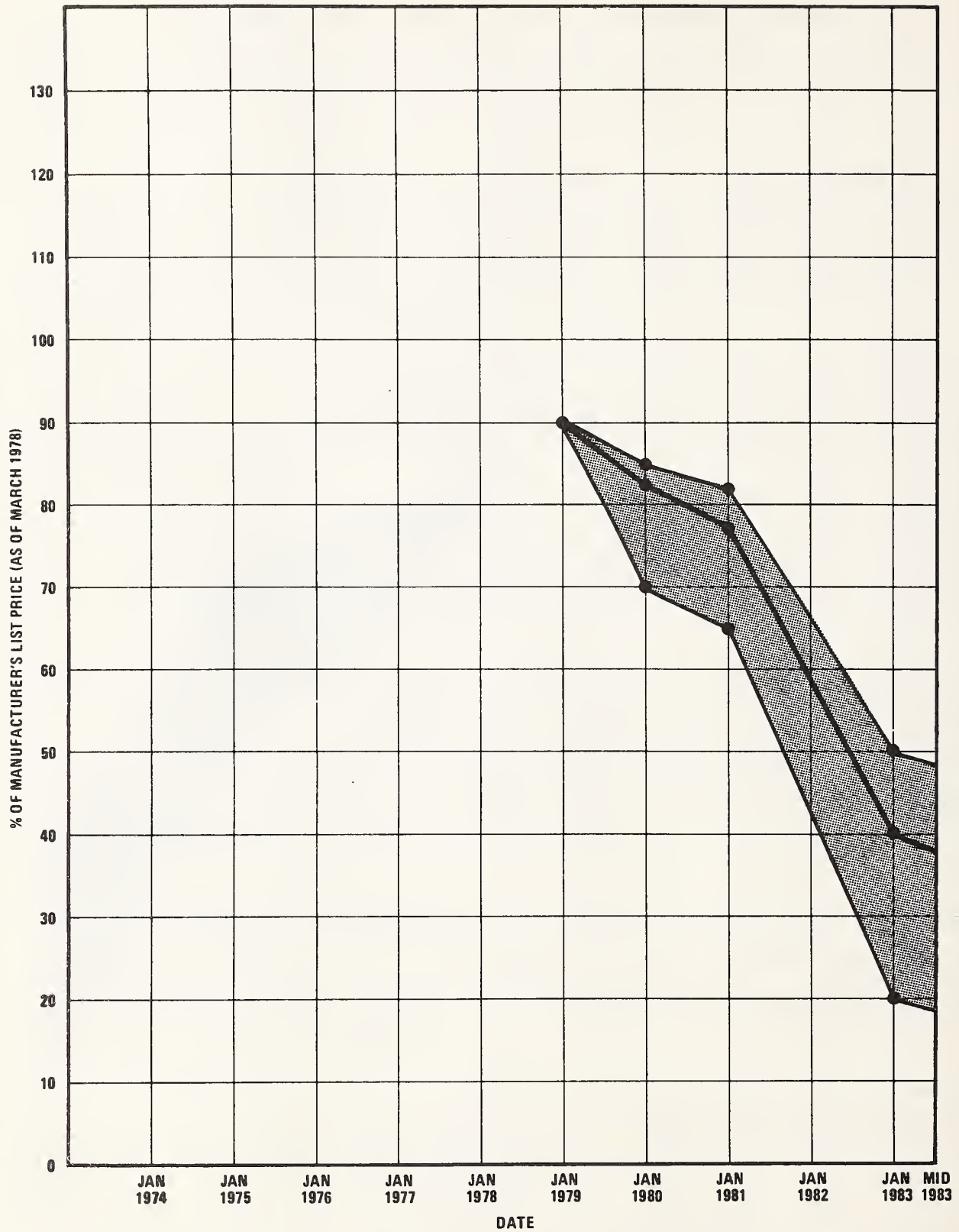


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	85%	82%	66%	50%
EXPECTED	83%	78%	59%	40%
LOW	70%	65%	42%	20%

- Amdahl will maintain its financial, maintenance, and support capability.
- Actions which affect the 303X series processors will have a similar impact on the Amdahl processors.
- INPUT projects IBM will make announcements of upgrades, including firmware modules, for the 303X:
  - Intel plans to follow IBM in firmware for the AS/6 and projected AS/7 in such areas as Extended Facility. There will be time lags between IBM announcements and Intel reactions. The extent of Intel's success with this course of action is uncertain at this point. A similar strategy for RCA in the past was unsuccessful.
  - Amdahl, to date, has indicated it does not plan to emulate IBM in the firmware area, although functional compatibility will be retained.
  - Residual values for the Amdahl and Intel equipment will be related to the relative success of their strategies. Intel's strategy may make the residual values of its equipment relatively more attractive than Amdahl if greater similarity to IBM equipment is achieved. However, INPUT considers its strategy more difficult to follow in the long run.
- Currently, Intel residual values are projected to be in the same range as those of the equivalent Amdahl equipment, assuming equivalent price/performance. Intel's tactics of negotiating "system" prices (CPUs and peripherals) makes price/performance comparisons extremely difficult.
- The values projected in this report are, in general, higher than those presented in the "New Hardware Economics" study for the following reasons:
  - The delivery schedules for IBM's 303X series systems are not at the rate INPUT anticipated in June 1977 and will cause demand for large processors (on a worldwide basis) to remain stronger than forecasted.

- The trend toward adding rather than displacing CPUs is expected to continue and will reduce the supply of used CPUs available in the market.
- The surprisingly large order backlog for 303X CPUs - which use existing technology with solid profit margins - will motivate IBM to delay the introduction of a completely new CPU product line for as long as possible.
- All projections assume that, during the forecast period:
  - Current anti-trust litigation will cause no drastic changes in the structure or marketing freedom of IBM.
  - U.S. economy will not enter a major recession.
  - Current tax law concerning the acquisition and depreciation of computing equipment will not substantially change.

APPENDIX A: DETERMINANTS OF  
RESIDUAL VALUE





## APPENDIX A: DETERMINANTS OF RESIDUAL VALUE

- The following discussion applies specifically to large CPUs manufactured by IBM. Residual values for other kinds of computing equipment, including CPUs manufactured by other vendors, although influenced by the analyzed variables, have other dependencies peculiar to each product. Thus, the market characteristics for peripherals and non-IBM CPUs can be very different from that of large IBM CPUs.
- The "plug compatible" CPUs from Amdahl, Itel, and potentially others will, however, parallel IBM's equipment values provided:
  - The firms remain economically and technically strong in the view of the computer industry.
  - IBM software remains available and fully supported.
  - Hardware reliability and maintenance support compares favorably to IBM's.
- Residual value at any given point in the life of a processor is determined primarily by the ability of the device to perform useful work in both current and future time periods. CPUs generally do not wear out in the traditional sense of physical deterioration. Instead they tend to improve in reliability as they age since marginal quality electronic components are continuously weeded out.

- The work the processor can do within a specified time interval is a function of hardware architecture, the efficiency of the software, and the maintenance support applied to both.
- Historically, IBM products have had higher resale values than competitive products as a result of market dominance and a larger base of potential buyers rather than an inherent hardware or software product superiority. This relative advantage in value retention is also due to IBM's excellent maintenance policies. For example, a purchaser of IBM used equipment normally receives a guarantee that:
  - The equipment is working to specifications.
  - IBM maintenance support will be available following transfer of title (assuming the equipment has been under continuous IBM maintenance).
  - The purchaser can thus expect the used equipment to perform as well (perhaps better) than new equipment from the manufacturer.
- In recent years a major industry has developed, oriented around the buying and selling of used computers. As with other brokerage operations, used computer prices are sensitive to supply and demand conditions within the market at any given time.
- These short-term fluctuations fall generally within a range of "perceived value," which is a function of the price/performance ratios of alternative equipment choices and also expectations about future technology or pricing changes.
- Historically the dominant factor influencing used computer values has been the actions of IBM. Its pricing and maintenance policies on old equipment, coupled with the price/performance of new products, have had a direct effect on used equipment values.



- As long as IBM dominates the market it is likely that these values will be predictable on the basis of prior action.
- However, the various external forces which influence IBM actions are undergoing change. Influencing factors may be results of:
  - Anti-trust litigation.
  - The success of "plug compatible" CPU suppliers such as Amdahl and Itel.
  - Foreign competition in U.S. and world markets.
  - Trend toward distributed computing.
  - New technological developments.



APPENDIX B: HISTORICAL VALUE PATTERNS  
FOR USED IBM PROCESSORS



## APPENDIX B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS

- The residual values of IBM processors have followed fairly consistent patterns. During the first 2-4 years following introduction, used CPUs offered in the market have sold for essentially new list price. This price was discounted by 10-15% because of tax benefits relating to new equipment purchase (the Federal investment tax credit) and also for the warranty provided on new equipment. After this initial period, values have declined at 5-15% per year. The rate of decline has been a complex function of the many variables listed in Exhibit B-1.
- The exact value of a processor, at any given time, is dependent on the supply/demand relationship within the market at the time the user wants to buy or sell his CPU. Sellers have in the past often created an illusion of "over supply" by listing with dozens of brokers, a practice which ultimately affected adversely their selling price.
- Used IBM large processor prices underwent a relatively steep decline during 1974, as the 370/158 and 370/168 with VS software entered the market. This decline in used computer prices, with systems selling for less than their intrinsic value, was reversed in early 1975. Most used computer prices then increased for a sustained period of time.

## EXHIBIT B-1

### VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

#### I. IBM PRACTICES AND POLICIES

##### a. New Product Announcements

- Price/performance ratios relative to existing products.
- Ease of conversions, transitions, and lead time in obtaining new products.
- Ease of installation and maintenance.
- Affect on perceptions of IBM's technical direction.

##### b. Pricing Policies

- Price increases or decreases on existing products.
- Rental vs. purchase breakdown ratios.
- Lease plans and penalty provisions for lease termination.
- Purchase option accruals.

##### c. Maintenance Policies

- Availability and cost.
- Attitude toward other vendor modification of CPU to enhance function or speed.

## EXHIBIT B-1 (contd)

### VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

#### 2. ALTERNATIVE CPU SOURCES

##### a. Price/Performance Of Non-IBM Manufactured CPUs

- The impact of plug compatible mainframes (Amdahl, Itel, etc.) is significantly greater than the impact of other CPU manufacturers (e.g., CDC, Honeywell, etc.)

##### b. Third Party Leasing Companies

- Pricing policies for both CPUs and mixed, multivendor "systems."
- Inventory situation - many of the same companies are active in both buying and selling in the used market.

#### 3. OTHER VARIABLES

##### a. Tax Considerations

- Income tax incentives such as investment tax credit and accelerated depreciation.
- Property taxation.

##### b. General Economic Conditions

- Cost and availability of capital.
- Overall demand for new and used equipment.

- Similarly, used prices for the 370/135 and 370/145 actually increased, in some cases by 15-20%, in the months just prior to the 370/138 and 370/148 announcements; this was an obvious misinterpretation of IBM's intentions.
- The 370/138, 370/148, and 303X series processors announcements in 1976-77 established new price/performance curves within the industry.



APPENDIX C: ANALYSIS OF VARIABLES  
AFFECTING VALUES OF  
USED IBM COMPUTERS



## APPENDIX C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

- The variables listed in Exhibit B-I can be classified into two categories:
  - Some variables affect the intrinsic value of an installed CPU (e.g., the price/performance ratio of new product announcements). The 370/168-3 CPU has very similar performance characteristics to the 3032, however, the pricing is quite different (see Exhibit III-1). The value of the 370/168-3 should therefore closely follow the price of the 3032 - as long as the two CPUs are perceived to be essentially equivalent.
  - Other variables affect the supply/demand relationship in the marketplace (e.g., the lead time in obtaining new products). The demand for processing power was much greater than suppliers could provide following the 3032 product announcement. The 370/168-3's actual value was therefore considerably higher than its intrinsic value because a supply of the lower cost alternative was not available.
- Some products, such as the IBM 3211 printer, are introduced with little or no price/performance advantage over existing products. Therefore, the 1403 printer maintained a high residual value.

- The 370/138, 370/148, and 303X series processor announcements, on the other hand, incorporated better than two-to-one price/performance ratios over 370/135, 370/145, 370/158, and 370/168 processors. This dramatic drop in price/performance curves (relative to prior processor announcements) will cause a sharp decline in installed 370/135, 370/145, 370/158 and 370/168 market values.
- Transition to newer technology requires consideration of both software and hardware factors. Although computer manufacturers strive for software compatibility between "generations," some program modifications are almost always required.
- Trends toward more compact packaging of the CPU and related components, and reduced cooling requirements have simplified physical space planning for most new hardware installations. There may, however, be special requirements, such as the 370/168, 3032, and 3033 440 cycle power and internal chilled water cooling which necessitate costly site preparation expenses.
- Lead times in obtaining new products can vary from a few months to years. There are two significant time intervals to be considered:
  - The time interval from product announcement until the first installations begin (thus when "replaced" equipment enters the used market).
  - The time interval between announcement and when a given customer is scheduled for installation. That given customer may become a buyer in the used market if the new product is not available in time to meet his expanding requirements, or he may attempt to purchase an earlier delivery position from another customer, usually by paying a premium over the manufacturer's list price.
- New product announcements are generally analyzed in considerable detail. Consultants and other industry experts provide opinions on what the impact of the new product will be on current markets, and when appropriate, what new technological change the product portends. This tends to define the degree of technological obsolescence applicable to existing products.

- Price increases by the manufacturer have tended to stabilize the used market, while price decreases produce an opposite effect. In any event, both are generally passed through rapidly to the used computer market. Used equipment is normally listed as a percentage of the current new price, and this percentage has tended not to change when vendor list prices have changed. Exhibit C-1 shows the frequency and magnitude of price changes for 370/158 and 370/168 processors.
- The consent decree of 1956 altered IBM's rental-only policy and was the primary force in establishing the used computer industry. IBM has gradually changed the relationship between rental and purchase prices in a manner which encourages purchase, thus increasing the potential disruptive effect caused by the large number of units available to be traded in the used marketplace.
- Leasing plans offer yet another financing alternative when equipment changes are under consideration. The amount of the lease discount over short term rental rates is normally a function of:
  - The lease term.
  - Penalties for early termination.
- When contemplating early termination, it may be advantageous to sell the equipment in the used market rather than pay penalties. This depends on the amount of the penalties and the differential between the used market value and purchase cost, including accrued purchase option credits.
- The ability to sell accrued equity in equipment which has been under lease or rent has substantial impact on used equipment values. The monthly percentage decline in purchase price due to purchase option accruals is shown for 370/158, 370/168, and 303X series processors in Exhibit C-2. IBM policy is to apply accruals against current price lists, normally to a maximum of 50%.

EXHIBIT C-1

IBM PRICE CHANGES FOR 370/158 AND 370/168 PROCESSORS  
(FOR PROCESSORS WITH 2 MILLION BYTES OF MAIN MEMORY)

	INITIAL PRICE	1/1/75 PRICE	1/1/76 PRICE	5/20/76 PRICE	4/1/77 PRICE
370/158 (2/71 1st INSTALL) (% CHANGE)	\$1,999	\$2,159 (8%)	\$2,245 (4%)	\$2,105 (-6%)	\$1,460 (-31%)
370/168 (4/71 1st INSTALL) (% CHANGE)	\$2,898	\$3,130 (8%)	\$3,255 (4%)	\$3,162 (-3%)	\$2,204 (-30%)

(\$000)



# EXHIBIT C-2

## MONTHLY DECLINE IN PURCHASE PRICE DUE TO PURCHASE OPTION ACCRUALS WHEN RENTING FROM IBM UNDER MONTHLY RENTAL CHARGE (MRC) PLAN

CPU (4 MEGABYTE)	ACCRUAL RATE	% BEFORE 4/1/77 PRICE REDUCTIONS	% AFTER 4/1/77 PRICE REDUCTIONS	MAXIMUM ACCRUAL	MONTHS TO REACH MAXIMUM ACCRUAL	PURCHASE/ MRC RATIO
370/158	55%*	1.12%	1.50%	50%	31.6	31.7
3031	55%	—	1.63%	50%	30.7	33.8
370/168	55%*	1.07%	1.48%	50%	32.1	32.1
3032	55%	—	1.47%	50%	33.9	37.3
3033	50%	—	1.15%	59%	36	43.8

\*50% if under IBM Term Lease Plan



- The 30% or more price reduction on 370/158 and 370/168 processors on 4/1/77, immediately placed many rented and leased units at the 50% maximum accrual position. As long as the market value remains above 50%, a user who is renting a 370/158 or 370/168 which is no longer needed can exercise the purchase option, then sell the CPU for a profit.
- The availability of competent maintenance support at a reasonable cost is a critical factor in establishing the value of a used computer. IBM's policy of guaranteeing maintenance support, regardless of ownership, has enhanced IBM residual values relative to other vendors.
- The life (and thus value) of a used computer can be extended by capacity enhancements. Such capacity enhancements have been provided by IBM (e.g., the Model 3 upgrade for 370/158 and 370/168 processors) and also by the independent vendors, most notably by increasing main memory size over IBM-supported levels.
- Improvements in function or performance made to IBM CPUs by other vendors are viable only if IBM maintenance support to the base systems is not adversely effected.
- Third party leasing companies, such as Itel, provide attractive (relative to IBM pricing) lease rates for IBM equipment. Penalty provisions normally exist and produce consequences similar to those discussed above for IBM leases. The packaging of non-IBM peripherals with an IBM CPU also provides a "total system" alternative at substantial price discounts.
- Disposal of large inventories of used processors (or the threat of this) can influence short term supply and demand conditions within the market and thus impact used equipment value.
- The investment tax credit is normally available only on new equipment. Used equipment prices are thus discounted by at least the after-tax value of this credit. Other tax implications, such as allowable depreciation, must also be considered for any given transaction.

- Property taxes are related to the assessed value of the equipment. The lower taxation burden on used equipment alternatives can be a significant factor in the procurement decision.
- Although computers generally represent a very significant capital expenditure, the computer industry has been less sensitive to economic recessions than most other industries. Recessions will tend to dampen overall demand, but on the other hand, less costly used equipment alternatives become more attractive during periods of fiscal belt-tightening.
- Holding on to used equipment for too long has certain less tangible drawbacks. For example:
  - Programmers don't like working with obsolete equipment, therefore, the best and the most productive leave.
  - Conversion costs, when skipping a generation or two, can be very expensive.
  - "Quantum jumps" in sophistication of systems can cause severe problems because of the lack of qualifications and capabilities of existing staff to cope with them.



**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Small Establishment Service - Analyzes and forecasts small establishment ( < 500 employees) use of office, communication, and computer services and products. Applications requirements and economics are emphasized.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Computer and Office Equipment Maintenance
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$5,000 to over \$50,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1978 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.



## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have over 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2180 Sand Hill Road  
Menlo Park, California 94025  
(415) 854-3422

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
500 Chesham House  
150 Regent Street  
London, W1R 5FA  
England  
London 439-6288  
Telex 261426

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199

U  
RV2

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

RESIDUAL VALUE FORECASTS #2  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

OCTOBER 1978

Input Library  
Reference Only



## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts - Two reports providing detailed forecasts of residual values of major computer equipments for 1978-1983.
- Vendor Watch Reports - Six reports which analyze the probable moves of major computer/communications vendors in operating systems, DB/DC software, mainframes, Value Added Networks and mass storage.
- EDP and Communications Planning Report - Contains analyses and composite forecasts of both short and long-term plans of computer/communications users. Includes operating ratio data.
- Impact/Technology Reports - At least three in-depth analyses of the impact on users of projected technological, managerial, and personnel developments over the next five years.
- Case Study Reports - Containing details on successful approaches to significant management and planning problems facing clients.
- Conferences - National conference for all clients held at a convenient location in November. Local and regional conferences held according to client interest.
- Consulting Support - Individual consultation with research staff on an as-needed basis through telephone inquiries and visits.
- Presentations - INPUT staff make general or specific presentations to client management or staff at client's location.

**RESEARCH METHOD:** INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by a Steering Committee consisting of client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are founded on the judgement of INPUT's staff.
- Professional staff supporting this program have 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

Edward I. Metz, Principal  
INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ 07662  
(201) 368-9471

RESIDUAL VALUE FORECASTS #2  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES  
OCTOBER 1978



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES

## TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION .....	I
II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE CPU MARKETS .....	3
A. Used Market Activity (April - September 1978)	3
B. Vendor Activities (April - September 1978)	4
III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES .....	9
IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS .....	13
APPENDIX A: DETERMINANTS OF RESIDUAL VALUE .....	25
APPENDIX B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS .....	29
APPENDIX C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS .....	33



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES

## LIST OF EXHIBITS

	<u>Page</u>
II -1 Comparison Of Large IBM And Amdahl Processors	6
IV -1 Actual And Projected Values For IBM 370/158 Processor	14
-2 Actual And Projected Values For IBM 370/168 Processor	15
-3 Projected Values For IBM 303X Series Processors	18
-4 Projected Values For Amdahl 470 V/5 And V/6 And ITEL AS/5 And AS/6 Processors	20
-5 Projected Values For Amdahl 470/V7 And ITEL AS/7 Processors	21
B -1 Variables Affecting Values Of Used IBM Computers	30
C -1 Announcement Dates For 370/158 Series, 370/168 Series, And 370/195 Series CPUs	36
-2 IBM Price Changes For 370/158 And 370/168 Processors (For Processors With 2 Million Bytes Of Main Memory)	37
-3 Monthly Decline In Purchase Price Due To Purchase Option Accruals When Renting From IBM Under Monthly Rental Charge (MRC) Plan	39





## I INTRODUCTION



## I INTRODUCTION

- This Residual Value forecast is produced as part of the Planning Service for Computer and Communications Users. Data contained in this series of reports will be updated every six months. Other key issues, such as the future of IBM hardware and software, are the subjects of various other reports including the "Vendor Watch" series produced as another part of the User Planning Service.
- In April, 1978, INPUT published the first report of this continuing series on residual values of large IBM and IBM plug compatible CPUs. This report reviews significant events since March and updates the earlier residual value forecasts based on an analysis of recent developments.
- Forecasted residual values are provided for the IBM System/370 Model 158, System/370 Model 168, 3031, 3032 and 3033 CPUs, the Amdahl 470 V/5, V/6, and V/7 CPUs, and the ITEL AS/5 and AS/6 CPUs.
- This report analyzes, in Part A of Chapter II, market trading activity for the above CPUs since the April report and compares INPUT projections to actual market developments. Vendor activity since the prior report is reviewed in Part B of Chapter II.
- The dominant factors influencing residual values are:
  - Price/performance impact of new product announcements.

- Price changes by manufacturers on existing equipment.
- Rumor or announcement of significant technology advances (hardware and software).
- Supply/demand factors acting in the market as driven by relative end user saturation levels.

INPUT discusses these issues in Chapter III.

- Residual value projections for each of the CPUs covered by this report are given in Chapter IV. The used computer industry by convention always lists used equipment as a percentage of manufacturer's current list price. The projections shown in graphical form in Chapter IV follow this convention. Readers are cautioned to consider price changes which have occurred (and which are noted on the IBM System/370 Model 158 and System/370 Model 168 graphs) when analyzing their own unique situations. For instance, a two megabyte 370/158 selling at 60% of the current \$1.46 million list price would bring \$.88 million - a 42% return on the \$2.1 million price in effect before 4/1/77.
- Variables which affect residual values are discussed in some depth in the Appendices. It is an analysis of the complex interrelationships between these variables that produce the residual value forecasts provided in Chapter IV.
- Although this report considers only IBM System/370 Model 158 class CPUs and above, INPUT has been analyzing the mid-range CPU market; e.g., Vendor Watch report on "The Future of IBM Mid-range Systems 1978-1983" published in June 1978. Future reports may be expanded to include residual value studies of mid-range CPUs.
- INPUT also plans to include a price/performance analysis and residual value forecast for selected peripheral product lines (such as paging devices or tape units) as a supplement to this series. These plans will be reviewed with clients to determine the value of such additions to the residual value forecasting service.

## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE CPU MARKETS





## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE CPU MARKETS

### A. USED MARKET ACTIVITY (APRIL - SEPTEMBER 1978)

- There has been no trading in Amdahl or ITEL processors in the used market. With initial deliveries of Amdahl's V/7 CPUs in September 1978, and because of Amdahl's policy of giving delivery priority to customers with installed Amdahl CPUs, there is a high probability that Amdahl machines will enter the used market for the first time within the next few months.
- Trading in IBM System/370 Model 158 and System/370 Model 168 CPUs picked up noticeably compared to the prior June 77 - March 78 report period. Availability of 158 and 168 CPUs continued to improve during the current reporting period. Prices declined, however, at a rate greater than relative supply/demand ratios could justify. This was due to the psychological impact of the first 303X installations.
- Selling prices, which were in the high 70's as a percentage of list price in April, dropped to the low to mid 60's in August. 370/168 values, as a percentage of list price, tended to be slightly higher than 370/158s due to somewhat poorer availability.
- Market values were within the range of earlier INPUT projections, but tended to closely follow the "low" projected figures. First deliveries of 303X CPUs

dispelled any doubts that the 303X was real. Used 158 and 168 CPUs dropped in value more rapidly than expected due to:

- IBM's accelerated deliveries of 303X machines. IBM now intends to deliver in 1978 some 150-200 more 303X CPUs than originally scheduled.
- This in turn has had an enormous psychological impact (underestimated by INPUT) on the market. Some end users are now unwilling to pay a substantial premium over the 158 or 168 "intrinsic" value (i.e., relative value compared to 303X CPU), as they believe they can stretch present capacity now that 303X delivery dates are firm, with even some chance for improvement.
- Recent Amdahl installations have tended to displace CPUs (primarily 158s) rather than being added to existing capacity - a change from what occurred in the June 77 - March 78 period.

## **B. VENDOR ACTIVITIES (APRIL - SEPTEMBER 1978)**

- IBM announced an MP version of the 3033 in early April which:
  - Provides no additional features compared to the base 3033.
  - Yields (IBM estimate) 1.6 to 1.8 times the instruction rate of a single 3033 processor.
  - Costs approximately \$400,000 more than two non-coupled 3033s.

- The price/performance of this MP product, which was analyzed in some detail in the May 1978 Vendor Watch Report, "The Future Of Large Scale IBM Mainframes: (1978-1983)," is not impressive and had no direct impact on residual values.
- IBM shipped the first 303X CPUs in March 1978, two weeks earlier than their internal targeted date. It is believed that 600 to 650 303X CPUs will be installed before the end of 1978. Estimated delivery ratios by CPU type are:
  - 3031 - 50%
  - 3032 - 33%
  - 3033 - 17%
- In August, IBM divided the System Products Division (SPD) into two parts. One, retaining the SPD title, will focus on "intermediate performance range products" (i.e., 370/148 and below) while the other, called the Data Systems Division, will be responsible for the development and manufacture of "large, complex systems" (i.e., 370/158 and above.) This move is thought to facilitate IBM's development, planning, and marketing activities for the E series machines (to replace 115 through 148 CPUs) and H series machines (to replace 158-3033 CPUs).
- Both Amdahl and ITEL appear to be doing very well, each now averaging five to ten installations per month. ITEL installed this summer its first 370/168 equivalent AS/6 CPU at Addressograph/Multigraph and plans to have 20 to 30 installations before year end.
- Amdahl, in April, reduced prices on the V/5 and V/6 CPUs by 5%. They also unbundled channels by offering 8, 12, and 16 channel versions for both the V/5 and V/6. Previously, the V/5 came with 12 channels; the V/6 with 16 channels. Exhibit II-1 provides a comparison of the IBM System/370 Model 158, System/370 Model 168, 303X series, and Amdahl CPUs.

## COMPARISON OF LARGE IBM AND AMDAHL PROCESSORS

MANUFACTURER	CPU	INTERNAL PERFORMANCE	PRICE*/ PERFORMANCE	CYCLE TIMES (NSEC)		BUFFER MEMORY SIZE	CHANNELS		PURCHASE PRICE* (\$000's)		MONTHLY MAINTENANCE COST	
				MEMORY	MACHINE		STANDARD	OPTIONAL	CPU <sup>(1)</sup>	OPTIONAL CHANNELS	CPU <sup>(1)</sup>	OPTIONAL CHANNELS
IBM	370/158-3	1.0	1.0	920	115	16K	2	3	\$1,781	\$ 39	\$ 4,060	\$ 42
IBM	3031EF <sup>(4)</sup>	1.2	2.0	920	115	32K	6	-	\$1,220	-	\$ 4,660	\$2,067
IBM	370/168-3	2.9	1.3	320	80	32K	6 <sup>(2)</sup>	6 <sup>(2)</sup>	\$3,418	\$617	\$ 9,865	\$2,067
IBM	3032EF <sup>(4)</sup>	3.1	2.2	320	80	32K	6	6	\$2,162	\$360	\$10,210	\$ 730
AMDAHL	470V/5	3.3	2.6	300	32	16K	8	4 or 8	\$2,150	\$150,\$300	\$ 8,150	\$500,\$1,000
AMDAHL	470V/6-11	5.1	3.3	300	32	32K	8	4 or 8	\$2,580	\$150,\$300	\$ 8,250	\$500,\$1,000
IBM	3033EF <sup>(4)</sup>	5.6	3.0	290	58	64K	12	4	\$3,400	\$320	\$11,120	\$ 695
AMDAHL	470V/7	7.4	3.8	280	28	32K	12	4	\$3,480	\$150	\$ 9,250 <sup>(3)</sup>	\$500

NOTES: (1) CPU main memory size = 4 million bytes. Monthly maintenance cost is for 24-hour 7 day coverage. 24/7 coverage is standard for Amdahl. For IBM, there is a 39% surcharge to extend coverage from their basic 9/5 to 24/7

(2) The 168-3 uses outboard channels. For comparative purposes, both the standard and optional channel groups were assumed to be one 2870-byte multiplexer channel and five 2880-block multiplexer channels.

(3) IBM provides a one-year warranty on CPUs (90 days for 168 outboard channels). Amdahl commences maintenance charging on installation acceptance date.

(4) 3031, 3032, and 3033 processors assume use of MVS/SE. This IBM software, costing \$1,250/month, improves through-put an estimated 13%.

\*Purchase price as of 9/1/78

- In late June, Amdahl announced its first priced (\$250/month) software product - MVS/SE assist. This product simulates many of the IBM System/370 extended hardware instructions and allows the IBM MVS/SE operating system to run on Amdahl 470 systems. This eliminated a source of software incompatibility between Amdahl and IBM.
- In early September, ITTEL expanded its CPU product line downward with the introduction of the AS/3. This model has two versions with performance aimed at IBM's 370/138 and 370/148. The new CPUs are manufactured by National Semiconductor and incorporate for the first time 16K bit main memory chips.
- Amdahl plans to install the first 470 V/7 CPUs in September and to have about ten to fifteen in place by the end of the year. Their production facilities in Ireland will soon be on-line. Construction has started in California of an additional 131,000 square foot production facility.







### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES



### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES

- INPUT describes in considerable detail the expected technical development and new product planning for IBM large scale CPUs between now and 1983 in the May Vendor Watch Report, "The Future Of Large Scale IBM Mainframes (1978-1983)." The residual value forecasts in Chapter IV are based in part upon the projections in the May Vendor Watch Report.
- Among the key points contained in the May report were:
  - New hardware and software technology will be announced in 1980-81 with availability in 1981-82.
  - Hardware price/performance ratios will probably remain relatively stable until IBM's announcement of the new product line.
- Interim actions until the new product line is announced could be:
  - MP versions for the 3031 and 3032 may appear and be promoted as a stepping stone to advanced functions. Improved reliability, availability and servicability will be claimed to more than offset the degraded price/performance.
  - New storage devices, with perhaps some data management functions built in, will only be attachable to the 303X systems.

- Improvements to data base management systems will be made and could include such items as a firmware pre-processor for data base languages, a hardware "sort box" for handling indices and/or sort keys, and a hardware encryption box for data.
- A replacement for the 370X communications controller will be announced and will incorporate line encryption, security, and network accounting; it could handle portions of computer resource management and job scheduling for multiple processors to improve performance of 303X configurations.
- The new product line is projected to have the following characteristics:
  - Modular construction with multiple CPUs.
  - A virtual processor (VP) environment based on an extension of VM (virtual machine) concepts.
  - Ability to run all System/370 operating systems.
  - Ability to dedicate a "processor" to a specific user on either a real or virtual basis.
  - Price/performance improvements of three to four times the 3032.
- Amdahl is unlikely to introduce a major new processor prior to IBM's new product line unless forced to do so to meet competitive pressure. Amdahl has been evaluating mass storage and communication controller products as a means of expanding its product line. Furthermore, they could redesign the V/5 and V/6 CPUs with technology advances incorporated in the V/7.
- ITEL is expected to be the U.S. marketer of Hitachi's M 200H, a processor with equivalent power to Amdahl's V/7. ITEL has a very strong marketing force, and its "negotiated" prices for the AS series CPUs have been highly

competitive. ITEL has been studying IBM peripheral activity and intends to react quickly to expected IBM announcements in the DASD area and to also expand its peripheral product line.

- Significant price reductions on existing products are unlikely as long as production capacity is presold. However, should either ITEL or Amdahl find itself accumulating inventories, price cutting could result. INPUT believes this is an unlikely occurrence, and thus residual value forecasts assume reasonable price stability over the forecast period.
- The accelerating production capacity of IBM, Amdahl, and suppliers to ITEL - geared to meet current strong demand - will cause a corresponding accelerated entry of 370/158 and 370/168 CPUs into the used market in future periods. It appears reasonable to expect that worldwide demand will continue to grow at a rate sufficient to maintain a relatively stable supply/demand relationship for these processors; however, short term imbalances will cause five to ten percentage point fluctuations at given points in time.





#### IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS



#### IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the plug compatible mainframe manufacturers.
  - Analysis of technology development and how it effects the changing role of the large CPU in evolving communications/data base networks.
  - Analysis of other variables affecting residual values, as described in the Appendices.
- The residual value curves in Exhibits IV-1 and IV-2 show actual listing prices for IBM System/370 Model 158 and System/370 Model 168 processors through June 1978 and projected values through June 1983.
- The 370/158 forecasts average about five percentage points lower than those published last April. The 370/168 forecasts average about ten points lower. There are two reasons for this more pessimistic outlook:

# EXHIBIT IV-1

## ACTUAL AND PROJECTED VALUES FOR IBM 370/158 PROCESSOR

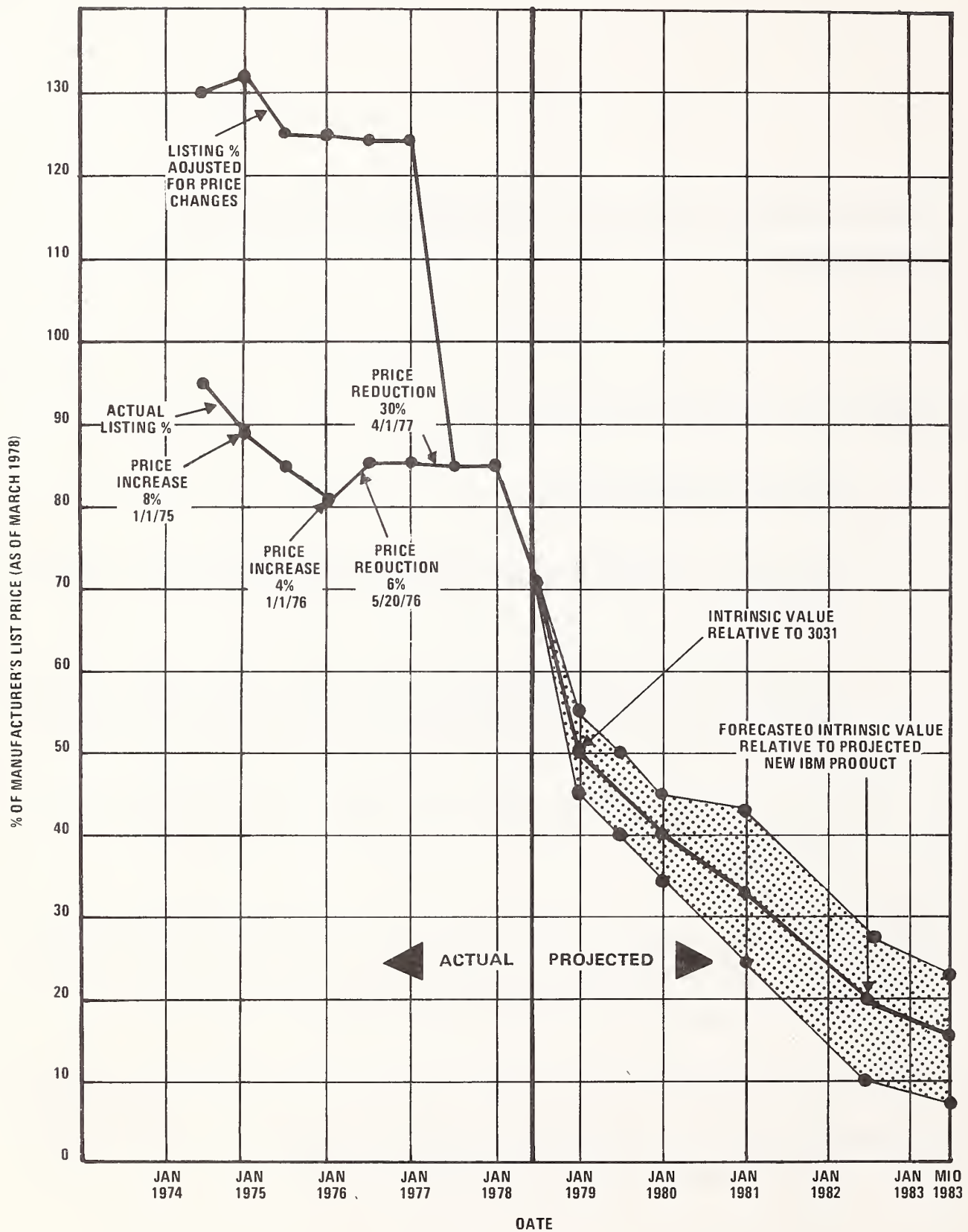


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	55%	45%	42%	32%	25%
EXPECTED	50%	40%	35%	25%	18%
LOW	45%	35%	25%	15%	9%

# ACTUAL AND PROJECTED VALUES FOR IBM 370/168 PROCESSOR

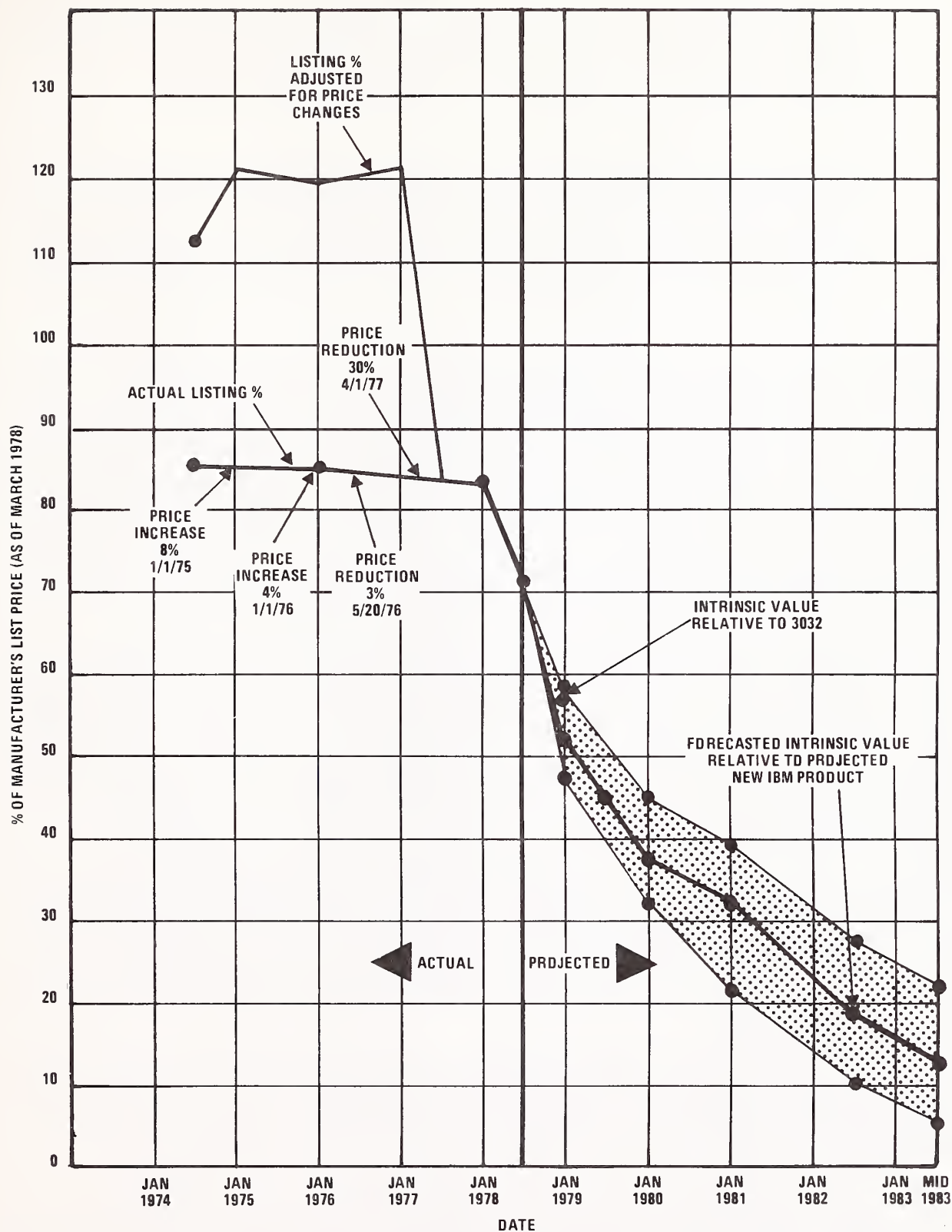


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	58%	45%	39%	32%	25%
EXPECTED	52%	38%	33%	23%	16%
LOW	47%	33%	22%	14%	5%

- The migration of 158 and 168 CPUs into the used market will be at a greater rate than originally projected. IBM and others are accelerating production of CPUs, some of which will replace 158s and 168s.
- INPUT projects that IBM will introduce products to alleviate data base management and communications deficiencies and that these products will be oriented towards MVS/SE and the 303X series. IBM would like the 303X to be the bridge machine to the new technology of the 1980's.
- Discussions with several used computer dealers and brokers indicate a common belief that there will be a surplus of 158 and 168 CPUs at 1978 year end. Reasons cited include: (a) accelerated efforts by vendors to complete installations to improve earnings reports; (b) lease terminations on a number of machines and; (c) decisions by end users to "bite the bullet" and take a book loss on sales in the current tax year, rather than postponing the loss until next year.
- INPUT thus expects 370/158 and 370/168 used CPUs to be selling at or below their 303X related intrinsic value by year end. Intrinsic value is the 303X price (3031 price for 158, 3032 price for 168) adjusted for internal performance factors.
- INPUT then expects these CPUs to decline in value until 1981 at about the rate experienced by large 360 series processors at the midpoint in their product life - adjusted somewhat for the announcement of products oriented towards 303X CPUs.
- The 370/158 is expected to retain its value slightly better than the 370/168 because:
  - The 158 is air cooled and thus has much greater flexibility and transportability (especially valuable in overseas markets).

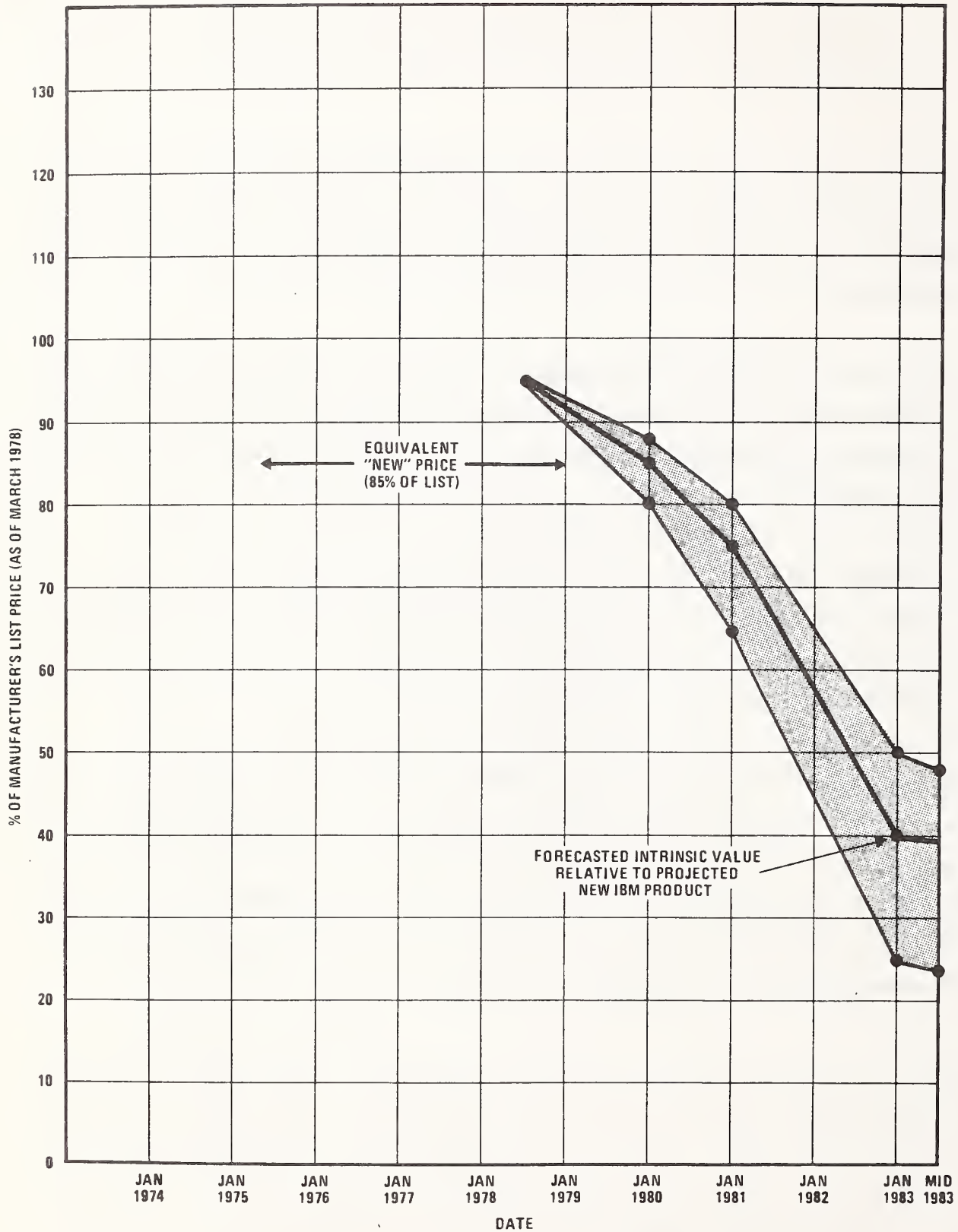


- The user base for 158 systems is much larger and to a certain degree less involved with very large data bases or complex communication networks.
- Relative uncertainty concerning these projections is defined by the shaded area above and below the expected value curve. Obviously the nature and timing of IBM product announcements is a significant component of this uncertainty.
- The forecasted curves for the IBM 303X series, the Amdahl V5-V7 series, and the ITTEL AS/5-AS/7 series remain unchanged from the April report. There have been no developments that significantly alter assumptions underlying these forecasts.
- For the IBM 303X series, from mid 1978 to January 1980 residual values will be higher than equivalent "new" price (considering ITC and warranty) because of demand, as shown in Exhibit IV-3. Transactions in this time period will be few, if any.
- The equivalent "new" price is primarily a function of the Investment Tax Credit (ITC). The 85% figure shown in the graph is an average of the net after tax value. For most companies, this net value will be between 80 and 90%, depending upon income tax rate applicable, CPU depreciation period selected, the ability to utilize all ITC generated on equipment acquisition, and whether ITC recapture later is required.
- Based on patterns with the 360 and 370 product series, we would expect residual values to then be maintained at equivalent new pricing for approximately 2 to 2½ years. However, INPUT expects the life cycle of the 303X to be shorter than normal since they are only extensions of the 370 series; therefore, we project a declining curve from equivalent new value, the rate of which will accelerate after the projected new product announcement in 1981.



# EXHIBIT IV-3

## PROJECTED VALUES FOR IBM 303X SERIES PROCESSORS



- The intrinsic value level of 303X CPUs relative to IBM's next product series is projected to be reached in late 1982 or early 1983. (This point is equivalent to the 370/158 and 370/168 "intrinsic value" points in early 1979 when these CPUs are compared to their 303X equivalents.)
- For Amdahl, and also Intel, plug compatible equipment, the span of uncertainty and downside risk are much greater than for IBM equivalents, as shown in Exhibits IV-4 and IV-5:
  - Only one chart for the 303X series is provided because the price/performance equivalency across the product line is expected to be maintained.
  - Two charts for Amdahl and ITTEL are provided because of the superior price/performance of the 470 V/7 and expected AS/7 relative to their other CPU products. This results in higher relative residual values for the V/7 and AS/7.
- Because of much shorter delivery lead times and a more limited market when compared to equivalent IBM equipment, ITTEL and Amdahl CPUs are not expected to sell above equivalent new values (possible exceptions are Amdahl 470 V/7 and projected ITTEL AS/7).
- The impact of the projected 1981 new product series on Amdahl and ITTEL CPUs will be similar to that shown for IBM CPUs.
- The relatively high downside risk associated with Amdahl processors is mainly the uncertainty regarding Amdahl's ability to retain close compatibility with IBM. INPUT projects that Amdahl is likely to retain this compatibility over the forecast period as reflected in the expected value curve. Other assumptions included in the Amdahl forecasts are:
  - Amdahl and ITTEL will maintain their financial, maintenance, and support capability.

# EXHIBIT IV-4

## PROJECTED VALUES FOR AMDAHL 470 V/5 AND V/6 PROCESSORS ITEL AS/5 AND AS/6 PROCESSORS

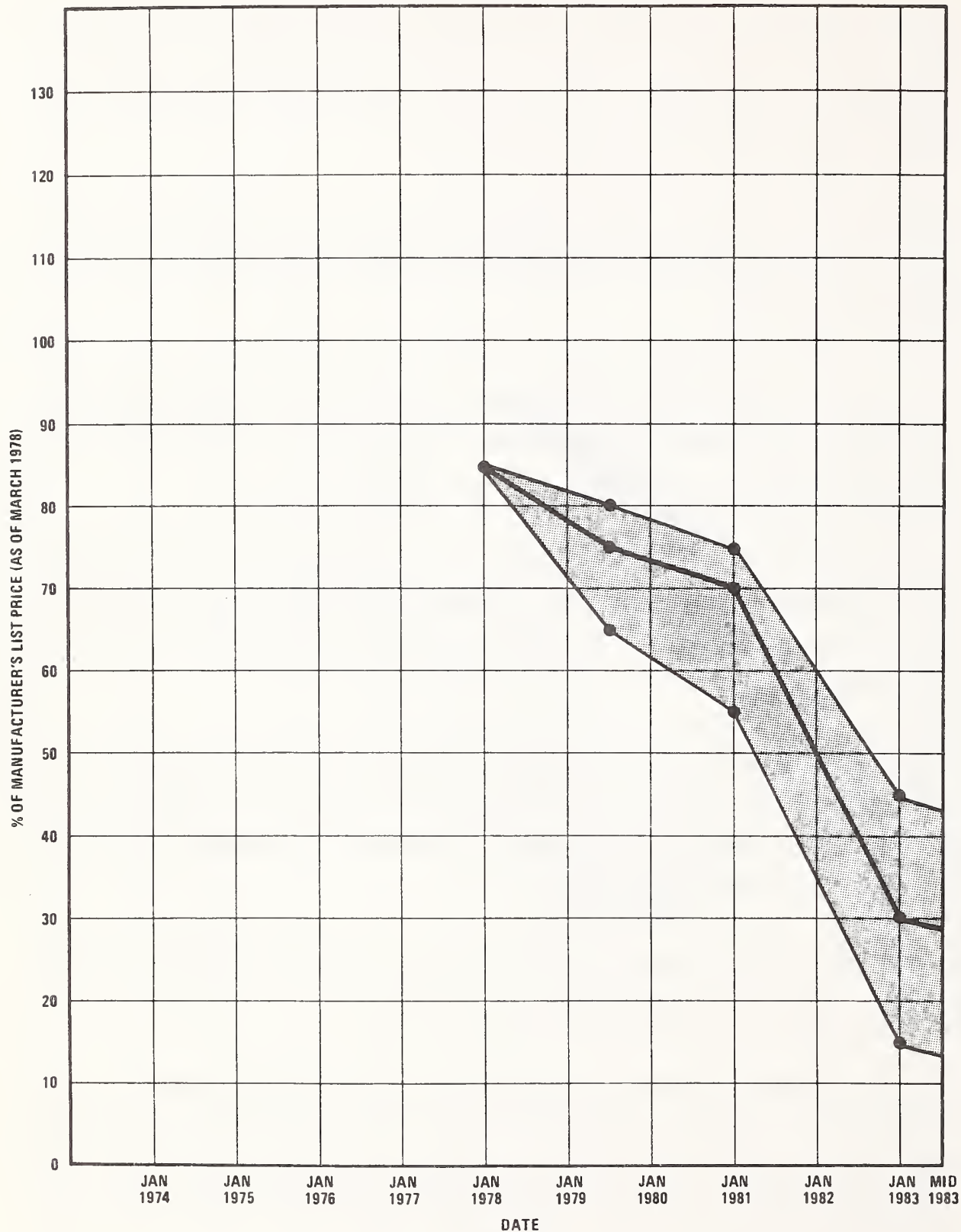


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1979	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	82%	78%	75%	60%	45%
EXPECTED	78%	73%	70%	50%	30%
LOW	72%	62%	55%	35%	15%

# EXHIBIT IV-5

## PROJECTED VALUES FOR AMDAHL 470 V/7 PROCESSOR ITEL AS/7 PROCESSOR

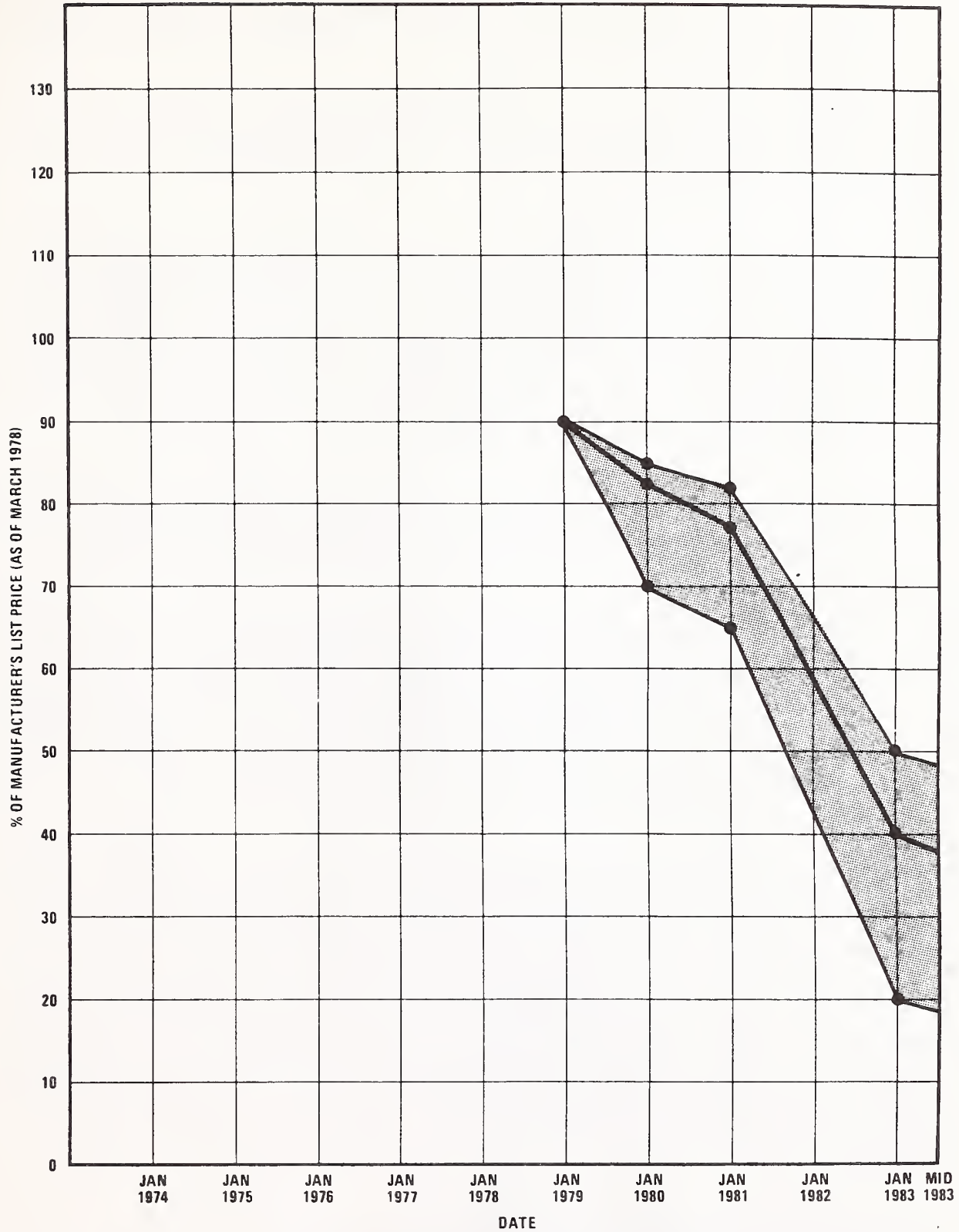


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983
HIGH	85%	82%	66%	50%
EXPECTED	83%	78%	59%	40%
LOW	70%	65%	42%	20%



- Actions that affect the 303X series processors will have a similar impact on the Amdahl processors.
- INPUT projects IBM will make announcements of upgrades, including firmware modules, for the 303X:
  - ITEL plans to follow IBM in firmware for the AS/6 and projected AS/7 in such areas as Extended Facility. There will be time lags between IBM announcements and ITEL reactions. The extent of ITEL's success with this course of action is uncertain at this point. A similar strategy for RCA in the past was unsuccessful.
  - Amdahl, to date, has indicated it does not plan to emulate IBM in the firmware area, although functional compatibility will be retained.
  - Residual values for the Amdahl and ITEL equipment will be related to the relative success of their strategies. ITEL's strategy may make the residual values of its equipment relatively more attractive than Amdahl if greater similarity to IBM equipment is achieved. However, INPUT considers its strategy more difficult to follow in the long run.
- Some financial analysts have discounted future ITEL CPU residual values relative to Amdahl because of ITEL's ability to discontinue its CPU line if difficult times ensue. While ITEL is not as dependent on its CPU product line for financial survival as is Amdahl, INPUT does not consider this factor significant. ITEL's recent expansion of its CPU product line, its plans to enlarge its peripheral product development effort, and its large software support group and field engineering force would make decommitment very difficult.
- All projections assume that, during the forecast period:
  - Current anti-trust litigation will cause no drastic changes in the structure or marketing freedom of IBM.

- U.S. economy will not enter a major recession.
- Current tax law concerning the acquisition and depreciation of computing equipment will not substantially change.





## APPENDIX A: DETERMINANTS OF RESIDUAL VALUE



## APPENDIX A: DETERMINANTS OF RESIDUAL VALUE

- The following discussion applies specifically to large CPUs manufactured by IBM. Residual values for other kinds of computing equipment, including CPUs manufactured by other vendors, although influenced by the analyzed variables, have other dependencies peculiar to each product. Thus, the market characteristics for peripherals and non-IBM CPUs can be very different from that of large IBM CPUs.
- The "plug compatible" CPUs from Amdahl, Intel, and potentially others will, however, parallel IBM's equipment values provided:
  - The firms remain economically and technically strong in the view of the computer industry.
  - IBM software remains available and fully supported.
  - Hardware reliability and maintenance support compares favorably to IBM's.
- Residual value at any given point in the life of a processor is determined primarily by the ability of the device to perform useful work in both current and future time periods. CPUs generally do not wear out in the traditional sense of physical deterioration. Instead they tend to improve in reliability as they age since marginal quality electronic components are continuously weeded out.

- The work the processor can do within a specified time interval is a function of hardware architecture, the efficiency of the software, and the maintenance support applied to both.
- Historically, IBM products have had higher resale values than competitive products as a result of market dominance and a larger base of potential buyers rather than an inherent hardware or software product superiority. This relative advantage in value retention is also due to IBM's excellent maintenance policies. For example, a purchaser of IBM used equipment normally receives a guarantee that:
  - The equipment is working to specifications.
  - IBM maintenance support will be available following transfer of title (assuming the equipment has been under continuous IBM maintenance).
  - The purchaser can thus expect the used equipment to perform as well (perhaps better) than new equipment from the manufacturer.
- In recent years a major industry has developed, oriented around the buying and selling of used computers. As with other brokerage operations, used computer prices are sensitive to supply and demand conditions within the market at any given time.
- These short-term fluctuations fall generally within a range of "perceived value," which is a function of the price/performance ratios of alternative equipment choices and also expectations about future technology or pricing changes.
- Historically the dominant factor influencing used computer values has been the actions of IBM. Its pricing and maintenance policies on old equipment, coupled with the price/performance of new products, have had a direct effect on used equipment values.

- As long as IBM dominates the market, it is likely that these values will be predictable on the basis of prior action.
- However, the various external forces which influence IBM actions are undergoing change. Influencing factors may be results of:
  - Anti-trust litigation.
  - The success of "plug compatible" CPU suppliers such as Amdahl and ITEL.
  - Foreign competition in U.S. and world markets.
  - Trends toward distributed computing.
  - New technological developments.



APPENDIX B: HISTORICAL VALUE PATTERNS FOR  
USED IBM PROCESSORS





## APPENDIX B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS

- The residual values of IBM processors have followed fairly consistent patterns. During the first two to four years following introduction, used CPUs offered in the market have sold for essentially new list price. This price was discounted by 10-15% because of tax benefits relating to new equipment purchase (the Federal investment tax credit) and also for the warranty provided on new equipment. After this initial period, values have declined at 5-15% per year. The rate of decline has been a complex function of the many variables listed in Exhibit B-1.
- The exact value of a processor, at any given time, is dependent on the supply/demand relationship within the market at the time the user wants to buy or sell his CPU. Sellers have in the past often created an illusion of "over supply" by listing with dozens of brokers, a practice which ultimately affected adversely their selling price.
- Used IBM large processor prices underwent a relatively steep decline during 1974, as the System/370 Model 158 and the System/370 Model 168 with VS software entered the market. This decline in used computer prices, with systems selling for less than their intrinsic value, was reversed in early 1975. Most used computer prices then increased for a sustained period of time.

## EXHIBIT B-I

### VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

#### I. IBM PRACTICES AND POLICIES

##### a. New Product Announcements

- Price/performance ratios relative to existing products.
- Ease of conversions, transitions, and lead time in obtaining new products.
- Ease of installation and maintenance.
- Affect on perceptions of IBM's technical direction.

##### b. Pricing Policies

- Price increases or decreases on existing products.
- Rental vs. purchase breakdown ratios.
- Lease plans and penalty provisions for lease termination.
- Purchase option accruals.

## EXHIBIT B-1 (contd.)

### c. Maintenance Policies

- Availability and cost.
- Attitude toward other vendor modification of CPU to enhance function or speed.

## 2. ALTERNATIVE CPU SOURCES

### a. Price/Performance Of Non-IBM Manufactured CPUs

- The impact of plug compatible mainframes (Amdahl, ITEL, etc.) is significantly greater than the impact of other CPU manufacturers (e.g., CDC, Honeywell, etc.)

### b. Third Party Leasing Companies

- Pricing policies for both CPUs and mixed, multi-vendor "systems."
- Inventory situation - many of the same companies are active in both buying and selling in the used market.

## 3. OTHER VARIABLES

### a. Tax Considerations

- Income tax incentives such as investment tax credit and accelerated depreciation.
- Property taxation.

## EXHIBIT B-I (contd.)

### b. General Economic Conditions

- Cost and availability of capital.
- Overall demand for new and used equipment.
- Similarly, used prices for the 370/135 and 370/145 actually increased, in some cases by 15-20% in the months just prior to the 370/138 and 370/148 announcements; this was an obvious misinterpretation of IBM's intentions.
- The 370/138 and 303X series processors announcements in 1976-77 established new price/performance curves within the industry.

APPENDIX C: ANALYSIS OF VARIABLES AFFECTING  
VALUES OF USED IBM COMPUTERS





## APPENDIX C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

- The variables in Exhibit B-1 can be classified into two categories:
  - Some variables affect the intrinsic value of an installed CPU (e.g., the price/performance ratio of new product announcements). The 370/168-3 CPU has very similar performance characteristics to the 3032, however, the pricing is quite different (see Exhibit III-1). The value of the 370/168-3 should therefore closely follow the price of the 3032 - as long as the two CPUs are perceived to be essentially equivalent.
  - Other variables affect the supply/demand relationship in the market-place (e.g., the lead time in obtaining new products). The demand for processing power was much greater than suppliers could provide following the 3032 product announcement. The 370/168-3's actual value was therefore considerably higher than its intrinsic value because a supply of the lower cost alternative was not available.
- Some products, such as the IBM 3211 printer, are introduced with little or no price/performance advantage over existing products. Therefore, the 1403 printer maintained a high residual value.
- The 370/138, 370/148, and 303X series processor announcements, on the other hand, incorporated better than two-to-one price/performance ratios over 370/125, 370/145, 370/158, and 370/168 processors. This dramatic drop in

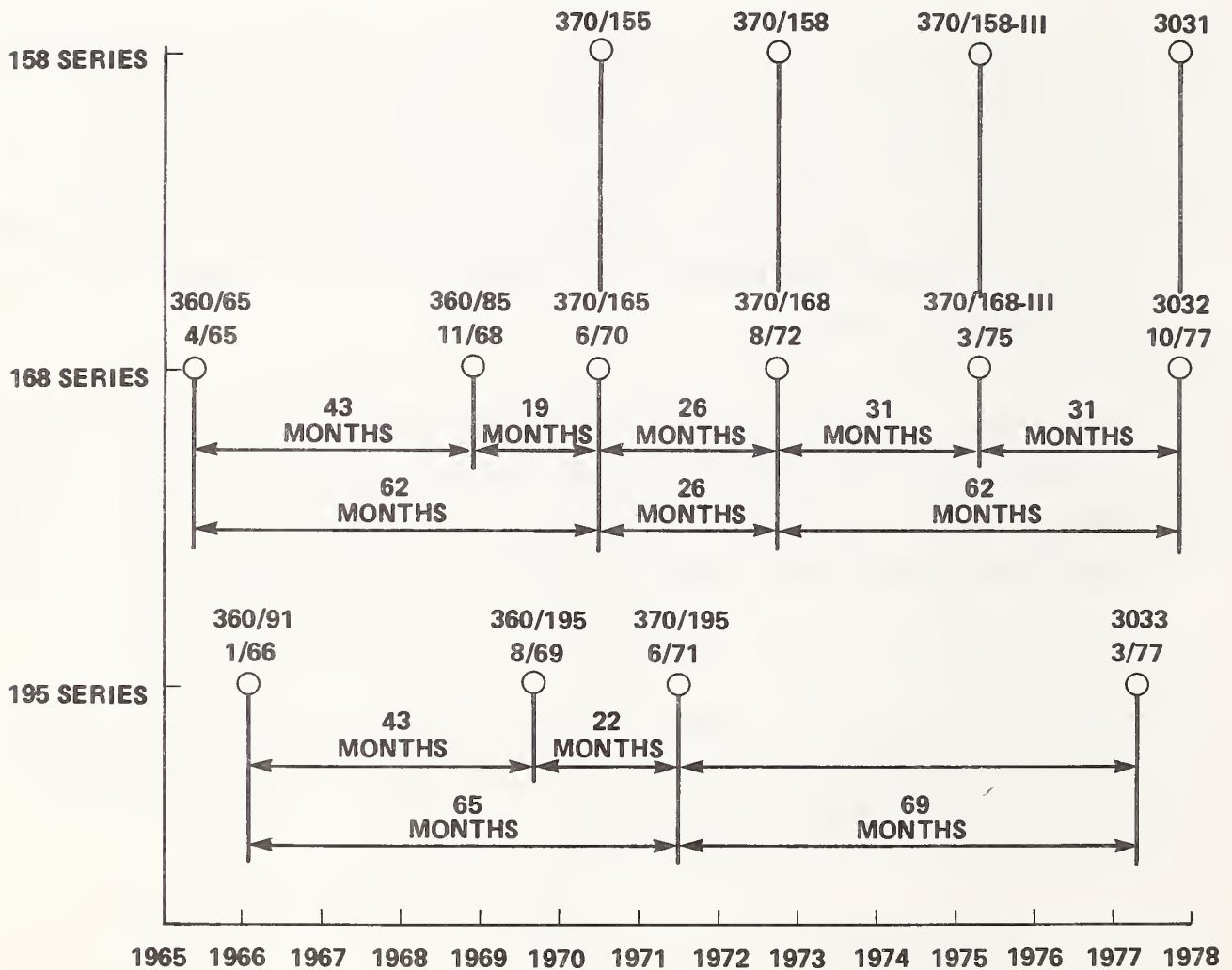
price/performance curves (relative to prior processor announcements) will cause a sharp decline in installed 370/135, 370/145, 370/158 and 370/168 market values.

- Transition to newer technology requires consideration of both software and hardware factors. Although computer manufacturers strive for software compatibility between "generations," some program modifications are almost always required.
- Trends toward more compact packaging of the CPU and related components and reduced cooling requirements have simplified physical space planning for most new hardware installations. There may, however, be special requirements, such as the 370/168, 3032, and 3033 440 cycle power and internal chilled water cooling, which necessitate costly site preparation expenses.
- Lead times in obtaining new products can vary from a few months to years. There are two significant time intervals to be considered:
  - The time interval from product announcement until the first installations begin (thus when "replaced" equipment enters the used market).
  - The time interval between announcement and when a given customer is scheduled for installation. That given customer may become a buyer in the used market if the new product is not available in time to meet his expanding requirements, or he may attempt to purchase an earlier delivery position from another customer, usually by paying a premium over the manufacturer's list price.

- New product announcements are generally analyzed in considerable detail. Consultants and other industry experts provide opinions on what the impact of the new product will be on current markets and, when appropriate, what new technological change the product portends. This tends to define the degree of technological obsolescence applicable to existing products. Exhibit C-1 provides announcement dates for the 370/158 series, 370/168 series, and 370/195 series CPUs.
- Price increases by the manufacturer have tended to stabilize the used market, while price decreases produce an opposite effect. In any event, both are generally passed through rapidly to the used computer market. Used equipment is normally listed as a percentage of the current new price, and this percentage has tended not to change when vendor list prices have changed. Exhibit C-2 shows the frequency and magnitude of price changes for 370/158 and 370/168 processors.
- The consent decree of 1956 altered IBM's rental-only policy and was the primary force in establishing the used computer industry. IBM has gradually changed the relationship between rental and purchase prices in a manner which encourages purchase, thus increasing the potential disruptive effect caused by the large number of units available to be traded in the used marketplace.
- Leasing plans offer yet another financing alternative when equipment changes are under consideration. The amount of the lease discount over short term rental rates is normally a function of:
  - The lease term.
  - Penalties for early termination.
- When contemplating early termination, it may be advantageous to sell the equipment in the used market rather than pay penalties. This depends on the amount of the penalties and the differential between the used market value and purchase cost, including accrued purchase option credits.

# EXHIBIT C-I

## ANNOUNCEMENT DATES FOR 370/158 SERIES, 370/168 SERIES AND 370/195 SERIES CPU'S



## EXHIBIT C - 2

IBM PRICE CHANGES FOR 370/158 AND 370/168 PROCESSORS  
(FOR PROCESSORS WITH 2 MILLION BYTES OF MAIN MEMORY)

	INITIAL PRICE	1/1/75 PRICE	1/1/76 PRICE	5/20/76 PRICE	4/1/77 PRICE
370/158 (2/71 1st INSTALL) (% CHANGE)	\$1,999	\$2,159 (8%)	\$2,245 (4%)	\$2,105 (-6%)	\$1,460 (-31%)
370/168 (4/71 1st INSTALL) (% CHANGE)	\$2,898	\$3,130 (8%)	\$3,255 (4%)	\$3,162 (-3%)	\$2,204 (-30%)

(\$000)



- The ability to sell accrued equity in equipment which has been under lease or rent has substantial impact on used equipment values. The monthly percentage decline in purchase price due to purchase option accruals is shown for 370/158, 370/168 and 303X series processors in Exhibit C-3. IBM policy is to apply accruals against current price lists, normally to a maximum of 50%.
- The 30% or more price reduction on 370/158 and 370/168 processors on 4/1/77, immediately placed many rented and leased units at the 50% maximum accrual position. As long as the market value remains above 50%, a user who is renting a 370/158 or 370/168 which is no longer needed can exercise the purchase option, then sell the CPU for a profit.
- The availability of competent maintenance support at a reasonable cost is a critical factor in establishing the value of a used computer. IBM's policy of guaranteeing maintenance support, regardless of ownership, has enhanced IBM residual values relative to other vendors.
- The life (and thus value) of a used computer can be extended by capacity enhancements. Such capacity enhancements have been provided by IBM (e.g., the Model 3 upgrade for 370/158 and 370/168 processors) and also by the independent vendors, most notably by increasing main memory size over IBM-supported levels.
- Improvements in function or performance made to IBM CPUs by other vendors are viable only if IBM maintenance support to the base systems is not adversely affected.
- Third party leasing companies, such as ITEL, provide attractive (relative to IBM pricing) lease rates for IBM equipment. Penalty provisions normally exist and produce consequences similar to those discussed above for IBM leases. The packaging of non-IBM peripherals with an IBM CPU also provides a "total system" alternative at substantial price discounts.

### EXHIBIT C - 3

#### MONTHLY DECLINE IN PURCHASE PRICE DUE TO PURCHASE OPTION ACCRUALS WHEN RENTING FROM IBM UNDER MONTHLY RENTAL CHARGE (MRC) PLAN

CPU (4 MEGABYTE)	ACCRUAL RATE	% BEFORE 4/1/77 PRICE REDUCTIONS	% AFTER 4/1/77 PRICE REDUCTIONS	MAXIMUM ACCRUAL	MONTHS TO REACH MAXIMUM ACCRUAL	PURCHASE/ MRC RATIO
370/158	55%*	1.12%	1.50%	50%	31.6	31.7
3031	55%	—	1.63%	50%	30.7	33.8
370/168	55%*	1.07%	1.48%	50%	32.1	32.1
3032	55%	—	1.47%	50%	33.9	37.3
3033	50%	—	1.15%	59%	36	43.8

\*50% if under IBM Term Lease Plan



- Disposal of large inventories of used processors (or the threat of this) can influence short term supply and demand conditions within the market and thus impact used equipment value.
- The investment tax credit is normally available only on new equipment. Used equipment prices are thus discounted by at least the after-tax value of this credit. Other tax implications, such as allowable depreciation, must also be considered for any given transaction.
- Property taxes are related to the assessed value of the equipment. The lower taxation burden on used equipment alternatives can be a significant factor in the procurement decision.
- Although computers generally represent a very significant capital expenditure, the computer industry has been less sensitive to economic recessions than most other industries. Recessions will tend to dampen overall demand, but on the other hand, less costly used equipment alternatives become more attractive during periods of fiscal belt-tightening.
- Holding on to used equipment for too long has certain less tangible drawbacks. For example:
  - Programmers don't like working with obsolete equipment; therefore, the best and the most productive leave.
  - Conversion costs, when skipping a generation or two, can be very expensive.
  - "Quantum jumps" in sophistication of systems can cause severe problems because of the lack of qualifications and capabilities of existing staff to cope with them.

**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Small Establishment Service - Analyzes and forecasts small establishment ( < 500 employees) use of office, communication, and computer services and products. Applications requirements and economics are emphasized.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Computer and Office Equipment Maintenance
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$5,000 to over \$50,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1978 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have over 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

**UNITED STATES, West Coast**  
2180 Sand Hill Road  
Menlo Park, California 94025  
(415) 854-3422

**UNITED STATES, East Coast**  
Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

**UNITED KINGDOM**  
INPUT Europe  
500 Chesham House  
150 Regent Street  
London, W1R 5FA  
England  
London 439-6288  
Telex 261426

**ITALY**  
PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

**JAPAN**  
Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090

**AUSTRALIA**  
Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199

U  
RV4

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

U-RV4

RESIDUAL VALUE FORECASTS  
FOR MULTIPLATTER, MOVING HEAD,  
DISK STORAGE SYSTEMS

JUNE 1979



## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts - Two reports providing detailed five-year forecasts of residual values of major computer equipment.
- Vendor Watch Reports - Six reports which analyze the probable moves of major computer/communications vendors in operating systems, DB/DC software, mainframes, Value Added Networks, mass storage and other areas.
- EDP and Communications Planning Report - Contains analyses and composite forecasts of both short and long-term plans of computer/communications users. Includes operating ratio data.
- Impact/Technology Reports - At least three in-depth analyses of the impact on users of projected technological, managerial, and personnel developments over the next five years.
- Conferences - National conference for all clients held at a convenient location in November. Local and regional conferences held according to client interest.
- Consulting Support - Individual consultation with research staff on an as-needed basis through telephone inquiries and visits.
- Presentations - INPUT staff makes general or specific presentations to client management or staff at client's location.

**RESEARCH METHOD:** INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are founded on the judgement of INPUT's staff.
- Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-I  
Saddle Brook, NJ 07662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Blvd.  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600

U-RU4

RESIDUAL VALUE FORECASTS  
FOR MULTIPLATTER, MOVING HEAD,  
DISK STORAGE SYSTEMS

JUNE 1979





RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER,  
MOVING HEAD, DISK STORAGE SYSTEMS

TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION .....	I
II HISTORICAL REVIEW OF IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE PRODUCTS .....	3
III MOVING HEAD DISK DEVICES IN THE MEMORY HIERARCHY .....	9
IV RESIDUAL VALUE FORECASTS FOR IBM 3330, 3350, AND 3370 DISK SYSTEMS .....	13



**RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER,  
MOVING HEAD, DISK STORAGE SYSTEMS**

**LIST OF EXHIBITS**

		<u>Page</u>
II	-1 IBM Multiplatter, Moving Head, Disk Storage Products	4
	-2 Comparative Characteristics of 2314, 3330-II, And 3350 Disk Drives	6
III	-1 The Memory Hierarchy	10
IV	-1 Price History of IBM 3330-I, 3330-II, 3350-B2 And 3370-B1 Disk Drives	14
	-2 Residual Value Forecast For IBM 3330-I Disk Drive	16
	-3 Residual Value Forecast For IBM 3330-II Disk Drive	17
	-4 Residual Value Forecast For IBM 3350-B2 Disk Drive	18
	-5 Residual Value Forecast For IBM 3370-B1 Disk Drive	19
	-6 List Purchase Prices For IBM Disk Products (6/79)	20



## I INTRODUCTION



## I INTRODUCTION

- This report on IBM multiplatter, moving head, disk storage systems is issued as an extension of the Residual Value Forecasts in INPUT's Planning Service for Computer and Communications Users. This report and others to be issued in the future on peripheral product lines are intended to complement the basic program which produces residual value forecasts of large IBM and plug compatible mainframes at six month intervals.
- These periodic supplements are not meant to provide in-depth technical analysis of the selected peripheral area. They are rather designed to provide financial managers an overview useful in evaluating device acquisition decisions.
- The investment in disk storage systems has grown rapidly at most computer installations. The declining trend in mainframe prices and the growing demand for on-line data storage is increasing the percentage of hardware dollars represented by disk devices. IBM is well aware of this trend and will continue to compete vigorously against the plug compatible suppliers.
- This report is provided in three sections:
  - Section II presents an historical review of IBM disk storage products.
  - Section III describes the position of moving head disks in the overall hierarchy of storage devices and discusses competing technologies.



- Section IV provides forecasts of residual values for IBM 3330-I, 3330-II, 3350, and 3370 products. Used market asking prices for prior periods are included where such data is available.

## II HISTORICAL REVIEW OF IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE PRODUCTS



## II HISTORICAL REVIEW OF IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE PRODUCTS

- IBM introduced its first disk storage device in 1956 -- the IBM 305 RAMAC. Since that time, seven major new product lines have been announced. Exhibit II-1 lists these products together with capacity, access times, and rental cost per megabyte of storage.
- The three disk storage technologies introduced by IBM which are still in widespread usage are:
  - 2314 - The industry standard of the mid 1960s, designed for 360 series mainframes. The plug compatible disk market developed around this product. A "double density" version was introduced by plug compatible manufacturers in the late 1960s.
  - 3330 - While still providing removable media, this product represented major improvements in performance and capacity, and was developed for the 370 mainframe series.
  - Winchester - Two different versions of this product, a mating of read/write heads with the magnetic media in a sealed package, have emerged. The 3340 version permits the "package" to be physically removed from the drive. The 3350 and 3370 versions do not.

**EXHIBIT II-1**  
**IBM MULTIPLATTER, MOVING HEAD, DISK STORAGE PRODUCTS**

IBM STORAGE DEVICE	YEAR ANNOUNCED	CAPACITY (MB)	AVG. ACCESS TIME (MILLISECONDS)	RENTAL COST/MB
305	1956	5.0	650	\$150.00
2311	1964	7.3	110	\$ 75.00
2314	1965	29.1	60	\$ 25.00
3330-1	1970	100.0	30	\$ 8.00
3330-11	1973	200.0	30	\$ 5.00
3340	1973	70.0	25	\$ 7.50
3350	1975	317.0	25	\$ 2.50
3370	1979	571.3	20	\$ 1.50

- Improvements in moving head disk storage systems have resulted from advances in three principal areas:
  - Increasing the areal density. The number of bits per square inch is dependent on two factors:
    - How close the tracks are positioned to each other (a function of the read/write head positioning equipment).
    - The number of magnetic flux changes achievable along the linear distance of the track (a function of the head sensitivity and distance between the head and the magnetic media).
  - Increasing the rotational speed. At any given areal density, the data transfer rate is a function of disk rpm speed.
  - Improving disk controller design. Disk controllers are highly sophisticated devices whose duties include sensing the position of heads relative to media, correcting errors, coding and decoding information, and generally supervising communications between the mainframe and the disk device.
- Exhibit II-2 presents comparative characteristics for 2314, 3330-II and 3350 drives indicating improvements as IBM has moved along the technology curve.
- The recently announced 3370 disk product (available for IBM 4300 CPUs only - at least for the present) is not a revolutionary design but does offer significant improvements in storage price, access time, and data transfer rates.

**EXHIBIT II-2**  
**COMPARATIVE CHARACTERISTICS OF**  
**2314, 3330-11, AND 3350 DISK DRIVES**

IMPROVEMENT AREA	2314 DEVICE	3330-11 DEVICE	3350 DEVICE
HEAD POSITIONING	Hydraulic actuator with mechanical track hold	Voice coil actuator with electronic track hold	Voice coil/rotary actuator with electronic track hold
HEAD FLYING HEIGHT	100 Microinches	45 Microinches	20 Microinches
MEDIA	Non-oriented magnetic	Non-oriented magnetic	Oriented magnetic
ROTATIONAL SPEED	2400 RPM	3600 RPM	3600 RPM
DATA TRANSFER RATE (MEGABYTE/SECOND)	312	809	1198
AREAL DENSITY (BITS/SQUARE INCH)	220,000	1,500,000	3,058,000



- At the time of announcement there was a 36% to 49% reduction in the price per byte of storage compared to the 3350 product line, a reduction in average access time from 25 to 20 milliseconds, and the data transfer rate was increased from 1.198 to 1.859 megabytes per second.
- A new read/write head design was introduced, about which little is currently known.
- Two new concepts introduced with the 3370 are:
  - Multiple head positioning actuators per spindle (two in the 3370) each separately addressable and thus independent from the other.
  - A new data recording technique using fixed block architecture.
- The multiple actuator approach is a logical way to mitigate growing user concerns over the very large volumes of data under a given set of heads. Future products will very likely follow this idea, with addressable units of 300 megabytes being a probable upper boundary.
- The fixed block architecture records data in permanent 512 byte blocks. Each block can be addressed as a unit or as part of a contiguous string of blocks. Data is thus mapped onto one or more blocks, which eliminates two problems:
  - First, a track is usually the smallest addressable unit. As track size has increased from 7,294 bytes in the 2314 to 19,069 bytes in the 3350, the amount of wasted space on partially filled tracks has increased.
  - Second, the changing track size has required adjustments in some user programs, always a nuisance.



### III MOVING HEAD DISK DEVICES IN THE MEMORY HIERARCHY



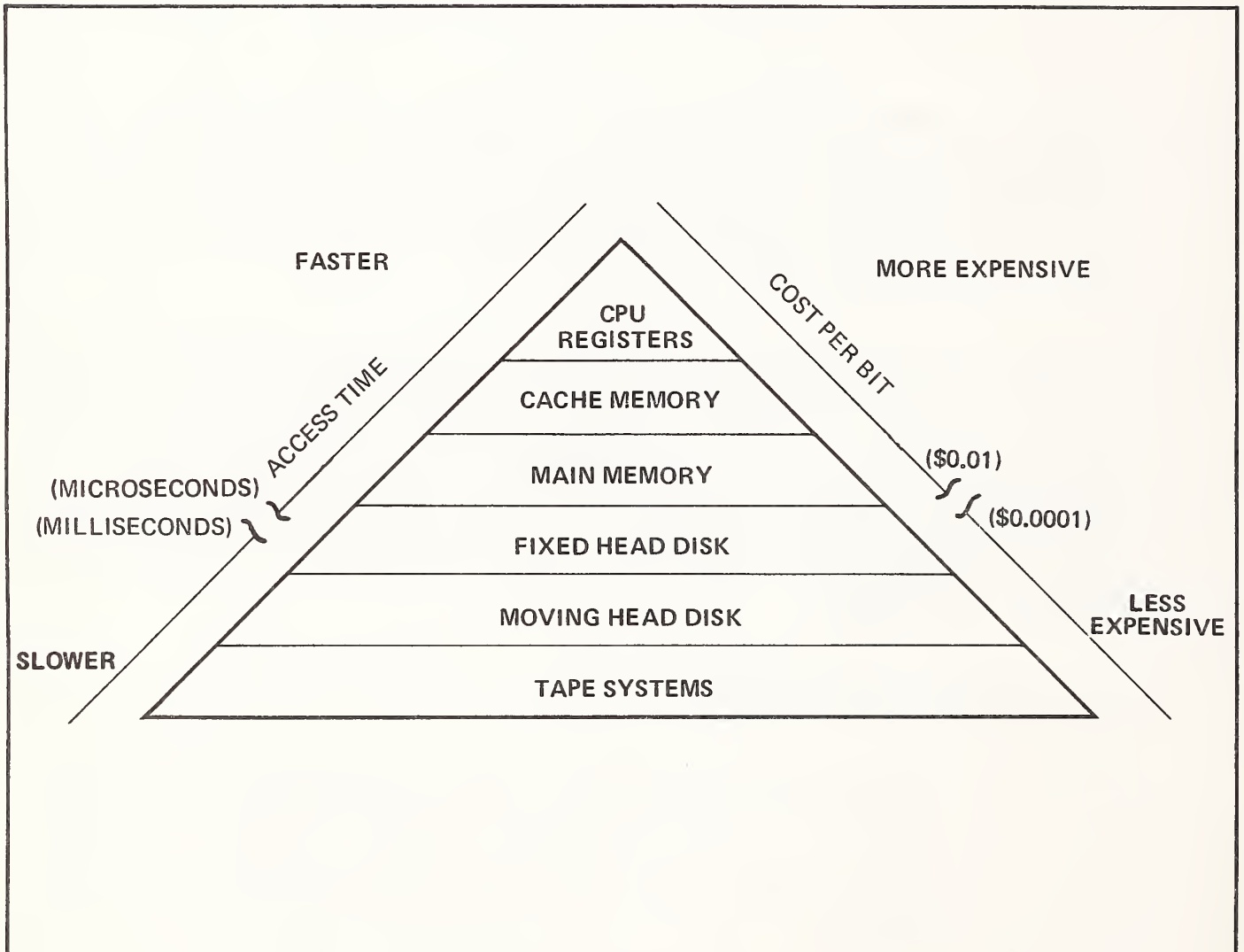
### III MOVING HEAD DISK DEVICES IN THE MEMORY HIERARCHY

- Computer systems generally employ a mixture of storage devices when processing information. The primary reason for this is the trade off between the SPEED at which information can be transferred to and from the storage medium and the COST of the information stored.
- In today's systems, a pyramiding effect can be seen as shown in Exhibit III-1. There is relatively little storage capacity internal to the CPU in the registers and memory when compared to secondary disk and tape systems. There is a significant gap between the two areas. New products based upon charge coupled devices (CCD's) and bubble memory technology are beginning to emerge to fill this gap.

#### - Charge Coupled Devices

- . Memorex 3770 Disk Cache -- up to 18 megabytes of CCD cache memory in which frequently accessed tracks are stored. Reduces access time from 20-40 milliseconds down to 2 milliseconds.
- . Storage Technology Corporation's STC-4305 Solid State Disk -- fully compatible with IBM's 2305 fixed head disk device, but with an access time of 0.7 milliseconds versus 5 milliseconds compared to the 2305-2.

EXHIBIT III-1  
THE MEMORY HIERARCHY



- Bubble Memory
  - . Texas Instrument's 765 computer terminal.
  - . Data Systems Design's floppy disk replacement.
  - . Microcomputer Systems Corporation's data acquisition terminal.
  - . AT&T for recorded speech.
- Bubble Memory will eventually significantly impact moving head memory. Magnetic disk capacity has been increasing at the rate of 300% every five years. Bubble memory chip density is increasing at a rate of 400% every two years. Continuation of these trends will lead to competing bubble memory products in the mid to late 1980s.
- Although CCDs provide faster access times, their volatility (loss of data when power is removed) make them an unlikely candidate to displace magnetic storage devices. They can be used for intermediate storage (such as virtual system paging or disk cache memories) where battery packs can temporarily retain power for data recovery.
- Magnetic disk memory systems are still far from their ultimate limits. Experts predict that areal densities will increase from the present day 6 million bits/sq. in. up to 100 million bits/sq. in. Thin film heads and greater use of microprocessors in the data location process are but two examples of work in development.
- For the next several years, technological obsolescence of current magnetic disk products will not stem from new competing technologies, but rather from advances within the magnetic recording technology itself.





IV RESIDUAL VALUE FORECASTS FOR IBM 3330,  
3350, AND 3370 DISK SYSTEMS



#### IV RESIDUAL VALUE FORECASTS FOR IBM 3330, 3350, AND 3370 DISK SYSTEMS

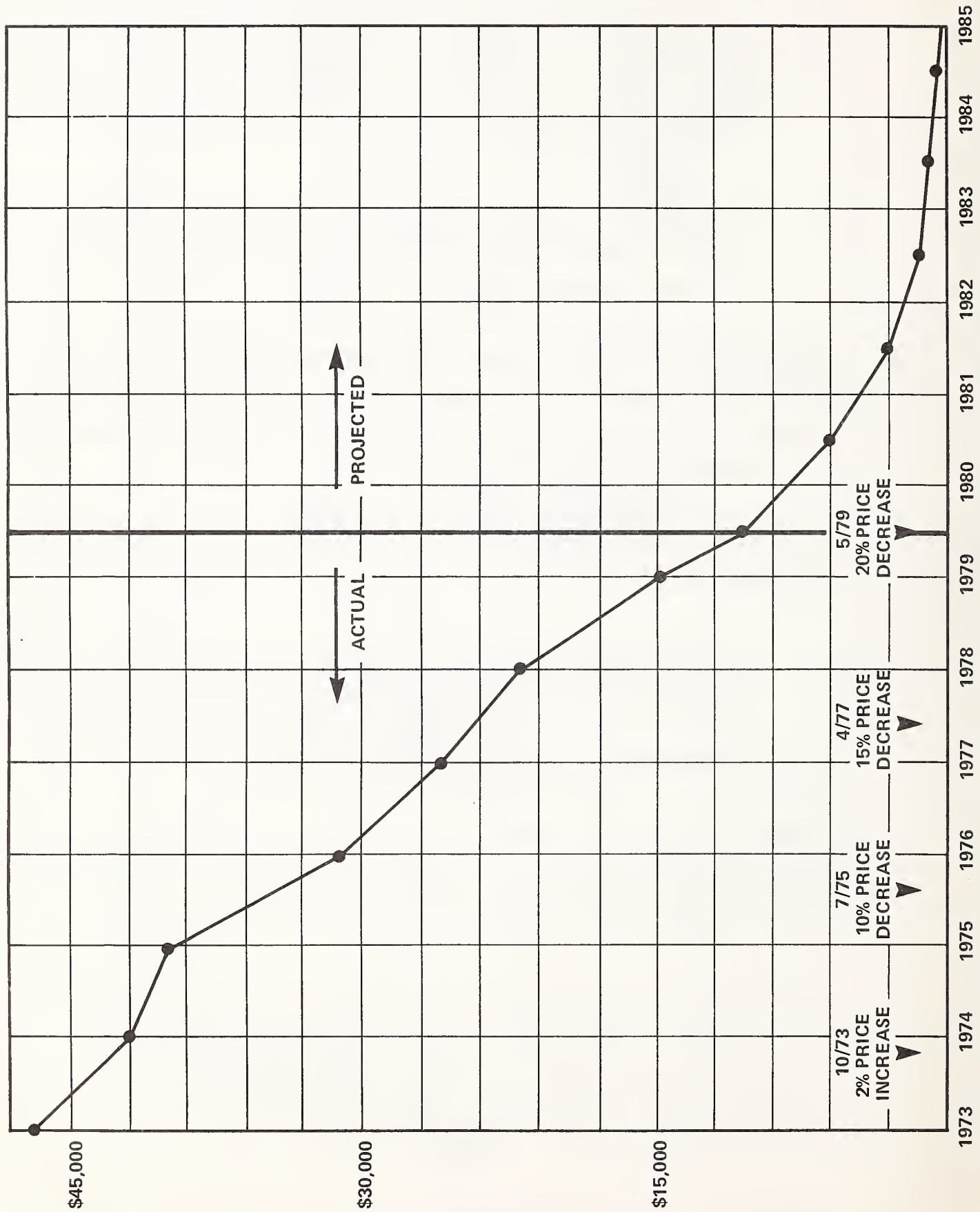
- The three principal forces influencing the residual values of IBM disk products have been:
  - New product announcements.
  - Price reductions on existing products.
  - Availability, either new from IBM or in the used market.
- In the past decade, new disk product announcements have appeared every two to three years. Each has provided greater storage capacity per spindle, higher data transfer rates and better RAS (Reliability, Availability and Serviceability) compared to prior generations. This trend is expected to continue through most of the 1980s.
- Price reductions have not followed such a predictable trend. Price reductions in the second half of the 1970s were more frequent and more aggressive than in the first half. Exhibit IV-1 provides a history of such price change actions.
  - It should be noted that IBM applies reductions uniformly across a given family. For example, the 3350 family has six models, depending upon the interface to the control unit and whether a set of fixed heads are included.

**EXHIBIT IV-1**  
**PRICE HISTORY OF**  
**IBM 3330-1, 3330-11, 3350-B2 AND 3370-B1 DISK DRIVES**

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
<div>3330-1</div> <div>200 MB</div> <div>(6/70)</div> <div>\$51,940</div> <div>\$260/MB</div>			<div>(10/73)</div> <div>\$52,900</div> <div>\$265/MB</div>		<div>(7/75)</div> <div>\$47,610</div> <div>\$238/MB</div>		<div>(4/77)</div> <div>\$40,470</div> <div>\$202/MB</div>		<div>(5/79)</div> <div>\$32,380</div> <div>\$162/MB</div>
		<div>3330-11</div> <div>400 MB</div> <div>(7/73)</div> <div>\$74,000</div> <div>\$185/MB</div> <div>(10/73)</div> <div>\$75,400</div> <div>\$189/MB</div>			<div>(7/75)</div> <div>\$67,860</div> <div>\$170/MB</div>		<div>(4/77)</div> <div>\$57,610</div> <div>\$144/MB</div>		<div>(5/79)</div> <div>\$46,090</div> <div>\$115/MB</div>
					<div>3350-B2</div> <div>635 MB</div> <div>(7/75)</div> <div>\$49,500</div> <div>\$78/MB</div>			<div>(10/78)</div> <div>\$39,600</div> <div>\$62/MB</div>	<div>(5/79)</div> <div>\$31,680</div> <div>\$50/MB</div>
									<div>3370-B1</div> <div>571 MB</div> <div>(2/79)</div> <div>\$23,400</div> <div>\$41/MB</div>

- The two price reductions (each 20%) since product introduction in 1975 have been uniformly applied to all models. Note in Exhibit IV-1 that the first 3350 price reduction did not follow the approximate 24 month price change cycle seen with the 3330 product series. This is attributed to the difficulty (and thus delay) in plug compatible manufacturers creating 3350 equivalent products.
- This pattern of uniform price changes across a given product line has also been followed with the 3330 series, and is expected to continue in future price changes.
- Availability from IBM can cause used products to sell for a premium. The 3350 has been sold at above equivalent new price from IBM (considering effects of investment tax credit and warranty) until recently -- a reflection of the long delivery times from IBM.
- Availability in the used market can be driven by end user purchase option accruals.
  - When 3350s began to reach end users in volume, the used market price for 3330s quickly settled at 55-60% of list. At this price, it was worth it for end users to "broker" their fully accrued equity position in the rented 3330s being displaced by incoming 3350s.
- Residual values for the 3330-I, the 3330-II, the 3350 B2, and the recently announced 3370 B1 are shown in Exhibits IV-2 through IV-5. These predictions assume the trends of the 1970s will continue through at least 1985.
- Residual values for other members of a given product series are proportional to the ratio of the respective list prices. For example, the forecasted residual value of the 3350 B2 (list price equals \$31,680) in mid 1982 is \$6,000 (as shown in Exhibit IV-4). The forecasted value in mid 1982 for the 3350 A2 (list price equals \$40,000) would be: 
$$\frac{\$40,000}{\$31,680} \times \$6,000 = \$7,576$$
- Exhibit IV-6 provides list prices as of June 1979 for IBM disk products.

EXHIBIT IV-2  
 RESIDUAL VALUE FORECAST FOR IBM 3330-1 DISK DRIVE  
 (PRODUCT ANNOUNCED JUNE 1970 AT A PRICE OF \$51,940)





# EXHIBIT IV-3 RESIDUAL VALUE FORECAST FOR IBM 3330-11 DISK DRIVE (PRODUCT ANNOUNCED JULY 1973 AT A PRICE OF \$74,000)

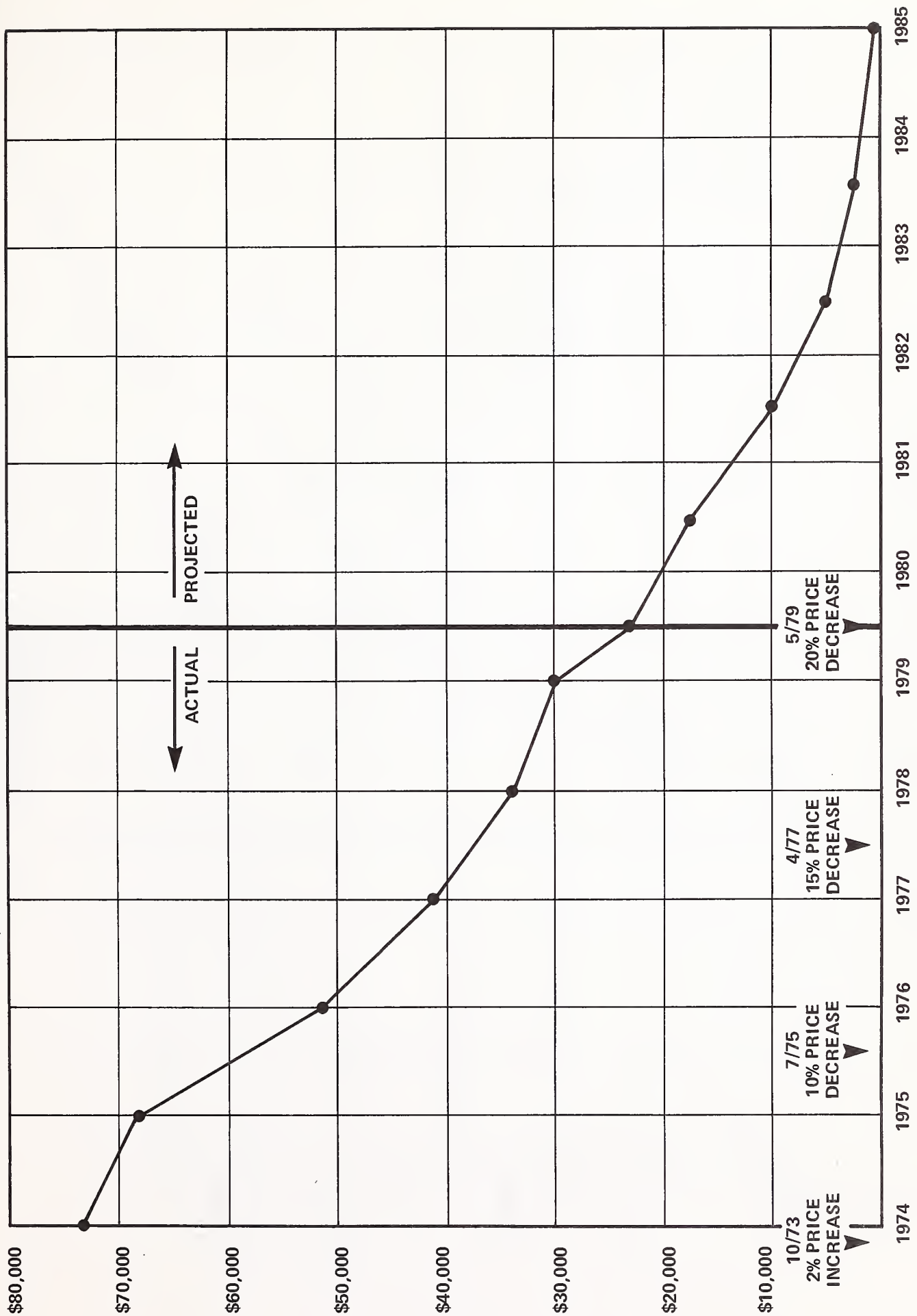


EXHIBIT IV-4  
 RESIDUAL VALUE FORECAST FOR IBM 3350-B2 DISK DRIVE  
 (PRODUCT ANNOUNCED JULY 1975 AT A PRICE OF \$49,500)

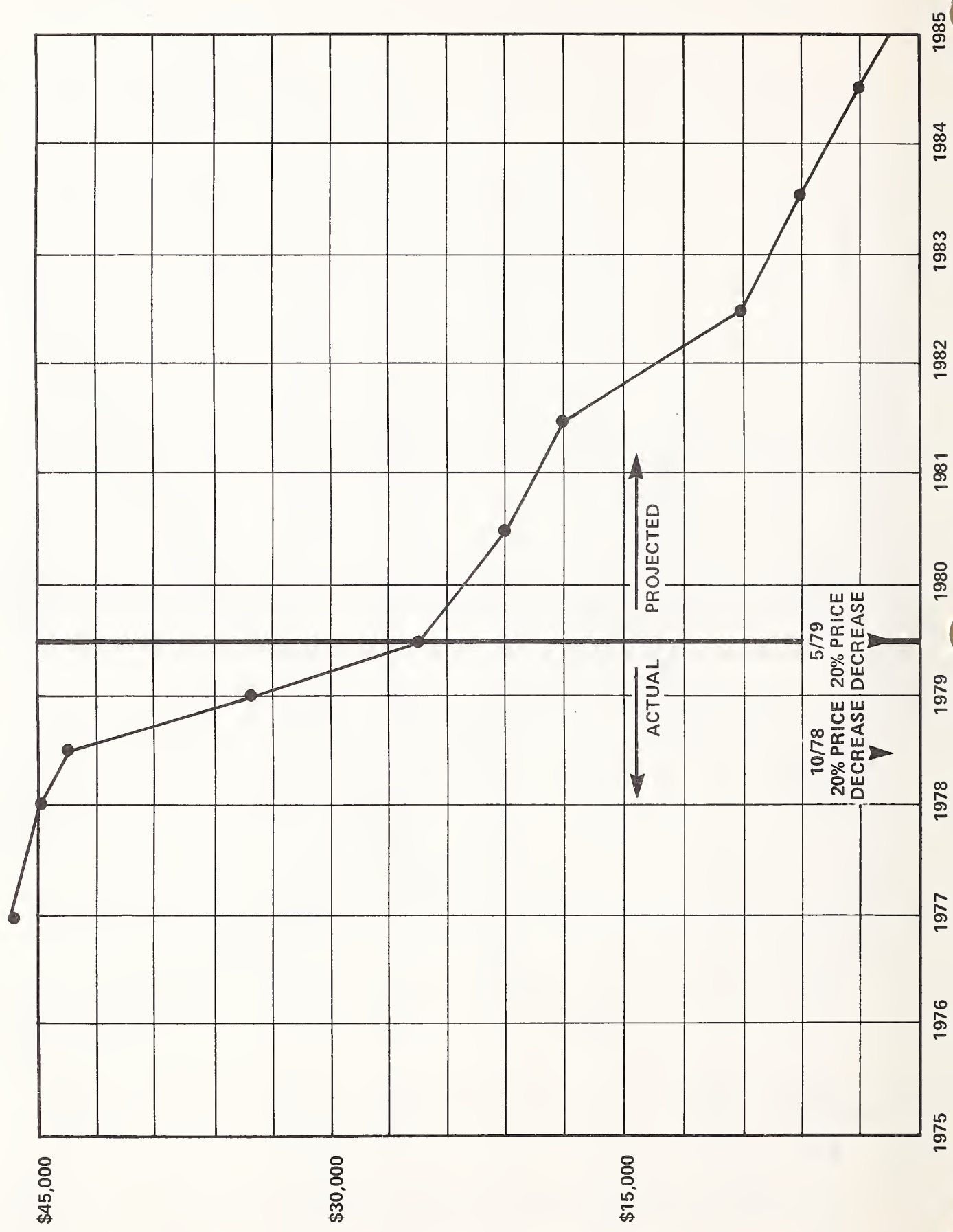
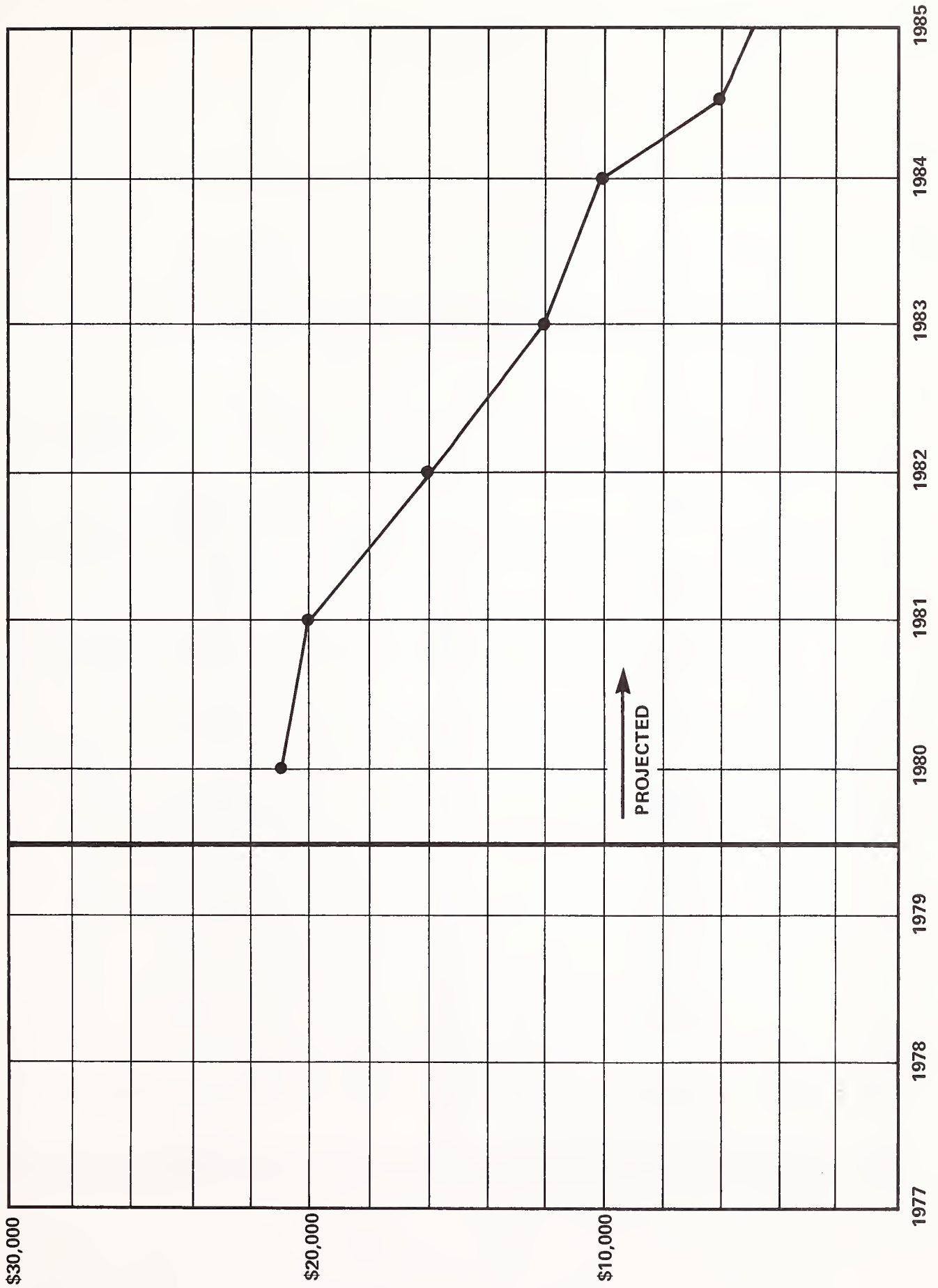


EXHIBIT IV-5  
RESIDUAL VALUE FORECAST FOR IBM 3370-B1 DISK DRIVE  
(PRODUCT ANNOUNCED MAY 1979 AT A PRICE OF \$23,400)



## EXHIBIT IV-6

### LIST PURCHASE PRICES FOR IBM DISK PRODUCTS (6/79)

PRODUCT	PURCHASE PRICE
3330-1	\$32,380
3333-1	40,580
3330-11	\$46,090
3333-11	54,290
3350-A2	\$40,000
3350-A2F	49,920
3350-B2	31,680
3350-B2F	41,600
3350-C2	41,380
3350-C2F	51,300
3370-A1	\$35,100
3370-B1	23,400





**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Small Establishments Service - Analyzes and forecasts small establishments' (< 500 employees) use of office, communication, and computer services and products. Applications requirements and economics and emphasized.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$50,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1978 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.



## **THE COMPANY**

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have over 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

## **UNITED STATES, West Coast**

2471 East Bayshore Blvd.  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

## **UNITED STATES, East Coast**

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

## **UNITED KINGDOM**

INPUT Europe  
Empire House  
414 Chiswick High Road  
London, W4 5TF  
England  
995-5397/8/9  
Telex 896739

## **ITALY**

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

## **JAPAN**

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090

## **AUSTRALIA**

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

U  
RV5

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

INPUT LIBRARY

U RV5

RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

OCTOBER 1979

## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts - Two reports providing detailed five-year forecasts of residual values of major computer equipment.
- Vendor Watch Reports - Six reports which analyze the probable moves of major computer/communications vendors in operating systems, DB/DC software, mainframes, Value Added Networks, mass storage and other areas.
- EDP and Communications Planning Report - Contains analyses and composite forecasts of both short and long-term plans of computer/communications users. Includes operating ratio data.
- Impact/Technology Reports - At least three in-depth analyses of the impact on users of projected technological, managerial, and personnel developments over the next five years.
- Conferences - National conference for all clients held at a convenient location in November. Local and regional conferences held according to client interest.
- Consulting Support - Individual consultation with research staff on an as-needed basis through telephone inquiries and visits.
- Presentations - INPUT staff makes general or specific presentations to client management or staff at client's location.

**RESEARCH METHOD:** INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are founded on the judgement of INPUT's staff.
- Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ 07662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Road  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600

U-RV5

RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

OCTOBER 1979



**RESIDUAL VALUE FORECASTS FOR LARGE IBM  
AND PLUG COMPATIBLE MAINFRAMES**

**TABLE OF CONTENTS**

	<u>Page</u>
I INTRODUCTION .....	I
II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE CPU MARKETS .....	5
A. Used Market Activity (April 1979 - October 1979)	5
B. Vendor Activities (April 1979 - October 1979)	7
III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES .....	13
IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS .....	17
APPENDIX A: DETERMINANTS OF RESIDUAL VALUE .....	29
APPENDIX B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS .....	33
APPENDIX C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS .....	39







# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES

## LIST OF EXHIBITS

	<u>Page</u>
IV -1 Actual And Projected Wholesale Values For IBM 370/158-3 Processor	18
-2 Actual And Projected Wholesale Values For IBM 370/168-3 Processor	19
-3 Projected Wholesale Values For The IBM 3031 Processor	22
-4 Projected Wholesale Values For The IBM 3032 And 3033 Processors	23
-5 Projected Wholesale Values For The Amdahl 470 V/5 And V/6 Processors	25
-6 Projected Wholesale Values For The Amdahl 470 V/7 And V/8 Processors	26
B -1 Variables Affecting Values Of Used IBM Computers	34
C -1 Announcement Dates For 370/158 Series, 370/168 Series, And 370/195 Series CPUs	42
-2 IBM Price Changes For 370/158 And 370/168 Processors (For Processors With 2 Million Bytes Of Main Memory)	43
-3 Monthly Decline In Purchase Price Due To Purchase Option Accruals When Renting From IBM Under Monthly Rental Charge (MRC) Plan	45



## I INTRODUCTION



## I INTRODUCTION

- This Residual Value Forecast is produced as part of the Planning Service for Computer and Communications Users. Data contained in this series of reports is updated every six months. Key issues, such as the future of IBM hardware and software and major product announcements, are the subjects of various other INPUT reports including the "Vendor Watch" series produced as another part of the User Planning Service.
- In March 1979, INPUT published the third report in its continuing series on residual values of large IBM and IBM plug compatible CPUs. This report reviews significant events since March and updates the earlier residual value forecasts based on an analysis of recent developments.
- Forecasted residual values are provided for the IBM System/370 Model 158-3, System/370 Model 168-3, 3031, 3032 and 3033 CPUs, and the Amdahl 470 V/5, V/6, V/7 and V/8 CPUs. Residual value forecasts for ITTEL CPUs are not included in this report. There is discussion in latter sections about ITTEL developments which have created such uncertainty, at the time of this report preparation, to preclude meaningful projections. ITTEL CPUs will be addressed in future analyses once National Semiconductor's market position is made clear.

- This report analyzes, in Section A of Chapter II, market trading activity for the above CPUs since the March 1979 report and compares INPUT projections to actual market developments. Vendor activity since the prior report is reviewed in Section B of Chapter II.
- In Chapter III, the report discusses the dominant factors influencing residual values. These include:
  - Price/performance impact of new product announcements.
  - Price changes by manufacturers on existing equipment.
  - Rumor or announcement of significant technology advances (hardware and software).
  - Supply/demand factors active in the market as driven by relative end user saturation levels.
- Residual value projections for each of the CPUs covered by this report are given in Chapter IV. The used computer industry by convention always lists used equipment as a percentage of the manufacturer's current list price. The projections shown in graphical form in Chapter IV follow this convention.
  - Readers are cautioned to consider price changes which have occurred (and which are noted on the IBM System/370 Model 158-3 and System/370 Model 168-3 graphs) when analyzing their own unique situations.
  - For instance, a two megabyte 370/158 selling at 40% of the current \$1.46 million list price would bring \$.58 million - a 28% return on the \$2.1 million price in effect before 4/1/77.

- Variables which affect residual values are discussed in some depth in the Appendices. It is an analysis of the complex interrelationships between these variables that produce the residual value forecasts provided in Chapter IV.
- INPUT also plans to continue a price/performance analysis and residual value forecast for selected peripheral product lines as a supplement to this series. The first such supplement, on IBM disk storage equipment was published in June 1979. The next report for peripheral residual values will be published in January 1980, and every six months thereafter.





## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE MARKETS



## II RECENT DEVELOPMENTS IN THE LARGE IBM CPU AND PLUG COMPATIBLE CPU MARKETS

### A. USED MARKET ACTIVITY (APRIL 1979 - OCTOBER 1979)

- This report period - April 1979 through October 1979 - was a time of relative stability in the 370/158 and 370/168 used market. As described in our previous residual value report, there had been a rapid decline in 158-3 and 168-3 values from 55-60% of list price in December 1978 down to the mid-30% by the end of April 1979.
- Since April, values have remained relatively stable for 168s and improved a bit for 158s. As always, short-term supply versus demand relationships - at any given point in time - can cause fluctuations of several percentage points in trading prices.
- INPUT's March projections were that 158s would be at 30% and 168s at 33% by the end of 1979. The used market has followed this direction quite closely.
- Trading activity in 158 and 168 CPUs was more active than during the prior report period. End users requiring additional capacity realized IBM's H Series product availability was probably two to three years away at best, and that short-term leasing (2-4 years) of 370s or 303Xs was the most sensible migration to the next generation.

- There were rumors in late spring about price cuts for the 303X Series, or perhaps even an early H Series model CPU, in time for presentation at the June National Computer Conference. This kept 158 and 168 wholesale prices (i.e., the amount a broker or dealer pays to acquire a CPU for resale or leasing) in the low 30%.
- In mid-June, IBM surprised most industry experts by raising rental and lease prices for 303X (also 158 and 168) CPUs. Delivery schedules for the new 4331 and 4341 products were also given to end users with many experiencing very long lead times.
- The combination of these two events caused a slight strengthening in 158 and 168 values, most notably for 158s. Wholesale prices for 158s are now (October 1979) in the mid to high 30%, depending on CPU configuration.
- Configuration is important. A Model 3 CPU with the Integrated Storage Control (ISC) and "madrids" (i.e., ISC features necessary for 3350 disk drive attachment) will command a 2-4 percentage point premium over a Model 1 CPU without the ISC.
- An IBM 3032 CPU was recently bought by a broker for \$1.6 million, which is 65% of the \$2.45 million list price. This selling price was well below the seller's expectations and reflects the current weak demand for 3032s and the belief among brokers that an aggressive price cut on 303Xs is eminent.
- Should a like transaction occur for the IBM 3031 CPU, we would estimate the price would range 65-70% of the list price. User demand for IBM 3031s has fallen below IBM's expectations, although not to the extent of the 3032.
- There were a few reported trades in Amdahl CPUs, mostly V/6s placed into leasing situations. The limited market and infrequent trading make generalizations difficult. The asking price for a V/6-II with eight megabytes memory and 16 channels is around 60% of manufacturer's list price. However, this same CPU is available on a three year net-net-net lease (i.e., lessee pays for

maintenance, property taxes, and insurance) at \$38-40,000 per month. The wholesale price necessary to support such a lease is in the 45-50% range.

- In reviewing used market activity, a disturbing trend was commented on by a number of sources. In recent months, there apparently has been a much higher frequency of renegeing (i.e., the failure of a broker or dealer to complete a transaction after agreeing to purchase a CPU).
- There is obviously risk for the broker between the time a CPU is bought and the time it is resold. A rapid value decline, such as during the December 1978 - April 1979 period, can be disastrous for those brokers caught in the middle of such a transaction. An IBM announcement can trigger a rapid short-term drop in value.
- Thus, some brokers, in order to eliminate such risks, have stalled in completing a buy until the resale side is completed. If the resale side falls through, they then renege on the buy side.
- End users selling a CPU are, therefore, cautioned to have a sizable deposit in hand before considering a sale transaction as being concluded.

#### **B. VENDOR ACTIVITIES (APRIL 1979 - OCTOBER 1979)**

- IBM could be best characterized during this report period as the wary boxer content to probe lightly at foes while conserving strength for the more important final rounds. Reported activities included:
  - In June, a 5% rental and lease rate increase for 158, 168, and 303X CPUs. Purchase and contract maintenance prices were not altered, increasing the attractiveness of outright purchase.



- Also in June, notification of 4331 and 4341 delivery schedules was given to end users. In some cases, first deliveries stretched into 1982.
- Further, initial 43XX deliveries are not what the customer ordered and installation and performance problems have been noted by the early customers.
- Second quarter earnings, reported in July, were well below expectations. The \$667 million figure was substantially under brokerage house predictions of \$775-800 million and was less than the \$691 million for second quarter 1978. This was the first down quarter in over four years and was caused by users leasing rather than buying CPUs.
- Third quarter earnings were 18% less than 1978's third quarter results. For the three months ending September 30, net was \$689 million compared to \$816 million in 1978. Analysts continue to predict another profit drop in the fourth quarter resulting from lower purchase sales, higher operating costs, and inflation.
- Maximum memory size of 3031 and 3032 CPUs was increased to eight megabytes. This August announcement confirmed rumors that these products are not meeting forecast projections and that memory, once in very tight supply, is more readily available. It is widely rumored that either 3031s or 3032s can be obtained in 60-90 days and also that a reduction in memory pricing from \$75,000 per megabyte to \$40-50,000 is likely to occur soon. It is also rumored that IBM has temporarily discontinued building new 3032 systems until new market strategies are announced and demand is increased.
- The price for 158 and 168 attached processor units was cut 25% in August. There are AP units for 158 and 168 CPUs available in the used market for which values were obviously altered by this announcement.



- A trade-in plan for 370/138 and 370/148 CPUs, similar to an earlier scheme for 370/158s, was announced in August. If the purchase of a leased CPU is culminated by October 31, 1979, the buyer is guaranteed a trade-in value on a new IBM product if purchased between July 1, 1981 and June 30, 1982. The amount of trade-in value varies from 15% to 7.3%, depending upon when trade-in occurs. See your IBM salesman for details!

- The major news at Amdahl was the potential merger with Memorex. If consumated, it will provide a much broader product and marketing structure which (at least according to stock market analysts) will be good for both entities. (However, now that Storage Technology Corporation (STC) is also courting Memorex, this merger/acquisition issue is confused). Other reported activities at Amdahl included:

- Two and four year lease plans, similar to IBM offerings, were announced in May. The leases are fully bundled in that maintenance, property taxes, and insurance are included. Amdahl normally takes the Investment Tax Credit (ITC). Purchase option accruals are 50% of lease payments to a maximum of 50% of list price.
- Some major leasing activities have already occurred between Memorex and Amdahl, possibly setting the stage for future financial involvements should the merger be culminated. Early in 1979, Memorex funded a totally owned lease subsidiary called Memorex Financial Company (MFC). It is reported that MFC recently negotiated the purchase of two Amdahl CPUs for long-term lease to Amdahl customers with Memorex peripherals attached. These transactions helped to boost Amdahl's second quarter earnings, but only slightly.

- Second quarter earnings, as with IBM, did not meet Wall Street expectations and for the same reason. A shift to leasing caused a revenue decline in the current period to where expenses and revenues were about the same. A \$260 million line of credit was arranged by Amdahl with a consortium of banks to support the growing lease base.
- Two new products were announced in August: the 470 V/7A CPU and the 470/Accelerator.
- The 470 V/7A CPU is rated by Amdahl at 75-85% of the 470 V/7, or roughly equivalent to IBM's 3033. It is upgradable in the field to a V/7 or V/8. A four megabyte 12 channel machine costs \$2.45 million. (First customer delivery in September 1979.) We understand the first installation was Michigan Blue Cross and the system was installed with no apparent problems.
- The 470/Accelerator is activated by operator command and is available on V/5 and V/7A CPUs. The claimed performance improvement when the Accelerator is "on" is 40-50% for the V/5 and 20% for the V/7A. The product can only be leased. The \$1,800/month minimum charge provides for up to 20 hours of use. Additional time is \$90/hour after the first 20 hours are utilized.
- In essence, a V/5 is a degraded V/6 and a V/7A is a degraded V/7. The "Accelerator" returns the machine to its original architecture with software and a meter to permit charging for the incremental performance the end user thereby obtains.
- New software products were announced in September. SVS support has been added to two new releases of Amdahl's Virtual Machine/Performance Enhancement (VM/PE). The new releases cost \$1,500/month and provide for 94-97% effective throughput of either SVS or MVS operating systems under VM.

- Amdahl software solutions to some of its customer problems will be offered as Amdahl Internally Developed Software (AIDS). The first AIDS products is the IMS/VS HDAM optimizer - designed to reduce I/O operations by 10-15% from IMS data base inquiries. The cost is \$5,400, spread over 24 monthly payments of \$225 per month.
- A hardware solution to a customer problem - his hardware monitor would not work on the V/7 CPU - is now available as the Hardware Measurement Interface (HMI). This product allows most commercial hardware monitors to work with V/7 and V/8 CPUs. Purchase price is \$40,000, or it can be leased for \$1,865/month (two-year term) or \$1,400/month (four-year term).
- ITEL, during this period, announced new products and new lease plans, but these were largely overshadowed by ITEL's retreat as a plug compatible vendor. The Data Products group lost \$70 million in the second quarter of 1979. This led to a sell off of several small divisions and culminated in late September with an agreement by which National Semiconductor took over almost all of Intel's Data Products group. The role of Hitachi, supplier of the AS/6 and the more recently announced AS/7 and AS/8 CPUs, is unclear. National Semiconductor will also assume maintenance responsibility for the sixty or so Hitachi made AS/6 machines presently installed in the U.S. Reported activities announced by Intel and assumed to be continued by NSC include:
  - A firmware package to reduce VM overhead and thus improve performance for the AS 703I CPU (reportedly by 35%) was announced in May. The cost is \$1,000/month.
  - One and two year lease plans for AS3 through AS5 Model 703I CPUs were made available in June. ITEL (now NCS) reportedly has a number of these CPUs in inventory and is seeking ways to place them without drastic price cutting.

- Two new CPU products were announced in July. Both the AS/7 and AS/8 products will be manufactured by Hitachi. Unless NSC can provide a comparable offering, it is assumed the Hitachi AS/7 and 8 products will be marketed by NSC - at least for the interim period.
- The dual processor AS/7 7033 is said to be equivalent in power to IBM's 3033. Like Amdahl (with its 7A), NSC now has a directly competitive product with the 3033. More importantly, NSC now has a growth path for existing AS/5 and AS/6 installations. This product supersedes the attached processor AS/6, which was announced last March. The AS/7, with fully redundant processors, can continue operation even if CPU fails. First customer shipment is October 1979. All the above assumes NSC continues to market and support prior ITEL announcements.
- The AS/8 is a direct descendent of Hitachi's M200-H, a product introduced over a year ago. First availability is July 1980, just after the expected announcement of IBM's H Series. ITEL withheld price information, waiting on IBM's pricing strategy for H Series. It remains to be seen what NSC will do. The AS/8's performance is measured on an 8 to 8½ MIPS (Millions of Instructions Processed per Second, with a 370/168 = 2.5 MIPS and a 3033 = 5 MIPS) system to be available at about the time delivery schedules for H Series CPUs are given to end users. Those with long lead times will be prime marketing targets for both NSC and Amdahl.

### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES





### III FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES

- In May 1978 INPUT published the Vendor Watch Report, "The Future of Large Scale IBM Mainframes (1978-1983)." This report describes in considerable detail the expected technical development and new product planning expected from IBM through 1983, and is in part the basis for residual value forecasts in Chapter IV.
- IBM announcements since May 1978 have closely paralleled and validated INPUT projections. Examples include:
  - The 8100 series, which is part of the projected merging of computer and communications technologies.
  - 303X CPUs, AP and MP versions, which were predicted as interim moves to protect IBM's customer base.
  - The 43XX series, which was described in considerable detail in the Vendor Watch Report, "The Future of IBM Mid-Range Systems, 1978-1983."
- The subject report further predicted a new series of large scale processors in the 1980-81 time frame (now popularly referred to as the "H" Series). This new series is expected to incorporate an architecture permitting the decomposition of the CPU into several independent functional modules capable of executing systems codes in parallel.



- One possible marketing approach available to IBM is "multiple attached processor clusters" which can be MP coupled. IBM is developing this concept, which would permit up to 3 MAP units per master CPU.
- Off-loading to special purpose processors designed to do certain tasks very efficiently would be feasible. Such tasks may include I/O processing, data base management, file processing and language processing.
- Component technology is expected to follow historical trends (i.e., average 18-20% cost reduction per year). The semiconductor industry is working toward improving the switching speed-power product and on increasing yields to lower average chip costs.
  - Use of electron beam lithography will increase circuit packing density, resulting in continuing logic and memory component cost declines through the 1980s.
  - IBM is investing significant resources in developing cryogenic Josephson junctions, which may become the dominant circuit switching technology in the 1990s.
- In the near term, the most significant event affecting residual values will be the announcement of the H Series product line which most industry observers project will happen before or during the second quarter of 1980. Some significant features expected to be incorporated in this new series include:
  - Very large main memory capacities into the hundreds of megabytes. The 370/303X CPUs use 24 bit addressing, which limits main memory to 16 million bytes. IBM's new product line (NPL) will use a 32 bit addressing scheme.
  - Much faster channel data transfer rates to permit true hierarchical storage capabilities.

- A single memory management system, so that the user need not be concerned about where his data is located as processing takes place.
  - A total unbundling of hardware and software pricing. The hardware will cost \$200,000-\$250,000 per MIPS (i.e., a 3033 equivalent for \$1 to \$1.5 million).
  - Relatively low hardware maintenance pricing (compared to 370/303X) because of circuit redundancy and remote diagnostic capability, but increasingly higher software maintenance pricing.
- Price decreases for 303X processors are necessary to encourage the present large IBM lease base towards lease purchase conversion. A 20-30% price reduction, coupled with accrued purchase option credits, will make it financially attractive overall for many installations to convert to purchase and amortize over 2-3 years. This is a viable alternative rather than to continue leasing.
  - There is a presentation made frequently within IBM which draws parallels to the early automotive industry. It is titled "Eliminating the Chauffeur" and it points out the limits placed on car production when it was assumed a chauffeur was required to drive the vehicle. Once the need for a chauffeur was eliminated, demand for cars accelerated rapidly. Thus, in the longer term, IBM is moving towards removing those bottlenecks (i.e., the chauffeur) preventing the direct use of computing at virtually all levels within society. This means:
    - The ability to manufacture hardware without skilled assemblers and technicians. Currently, assemblers are now required to fit pieces together and test that they work.
    - Eliminating to a large extent the skilled technicians required to fix hardware when it fails. Even today IBM is having difficulty finding enough people trainable in the complexity of present systems.

- Removing the dependence on the professional programmer. IBM knows it must create user languages to replace programmer languages if widespread direct use of computing is to become commonplace. Further, programmer productivity is a key issue with users. Although hardware costs are declining, personnel costs continue to grow.
- The CPU is clearly becoming a smaller price component in the total computer system investment. IBM will develop ways to tie its new software and its new peripheral devices to its relatively inexpensive future CPUs as a method for maintaining revenue and market growth.
- In prior years, when CPU cost was dominant, IBM placed artificial constraints on CPU memory size and power to force end users to buy upward as capacity needs increased. This situation has now reversed itself, and IBM may sometime in the future essentially give away the CPU for commitments regarding software and peripheral purchases.

#### IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS



#### IV FUTURE RESIDUAL VALUES OF IBM AND PLUG COMPATIBLE PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the plug compatible mainframe manufacturers.
  - Analysis of technology development and how it affects the changing role of the large CPU in evolving communications/data base networks.
  - Analysis of other variables affecting residual values, as described in the Appendices.
- The residual value curves in Exhibits IV-1 and IV-2 show actual listing prices for IBM System/370 Model 158-3 and System/370 Model 168-3 processors through September 1979 and projected values to January 1984.



# EXHIBIT IV-1

## ACTUAL AND PROJECTED WHOLESALE VALUES FOR IBM 370/158-3 PROCESSOR

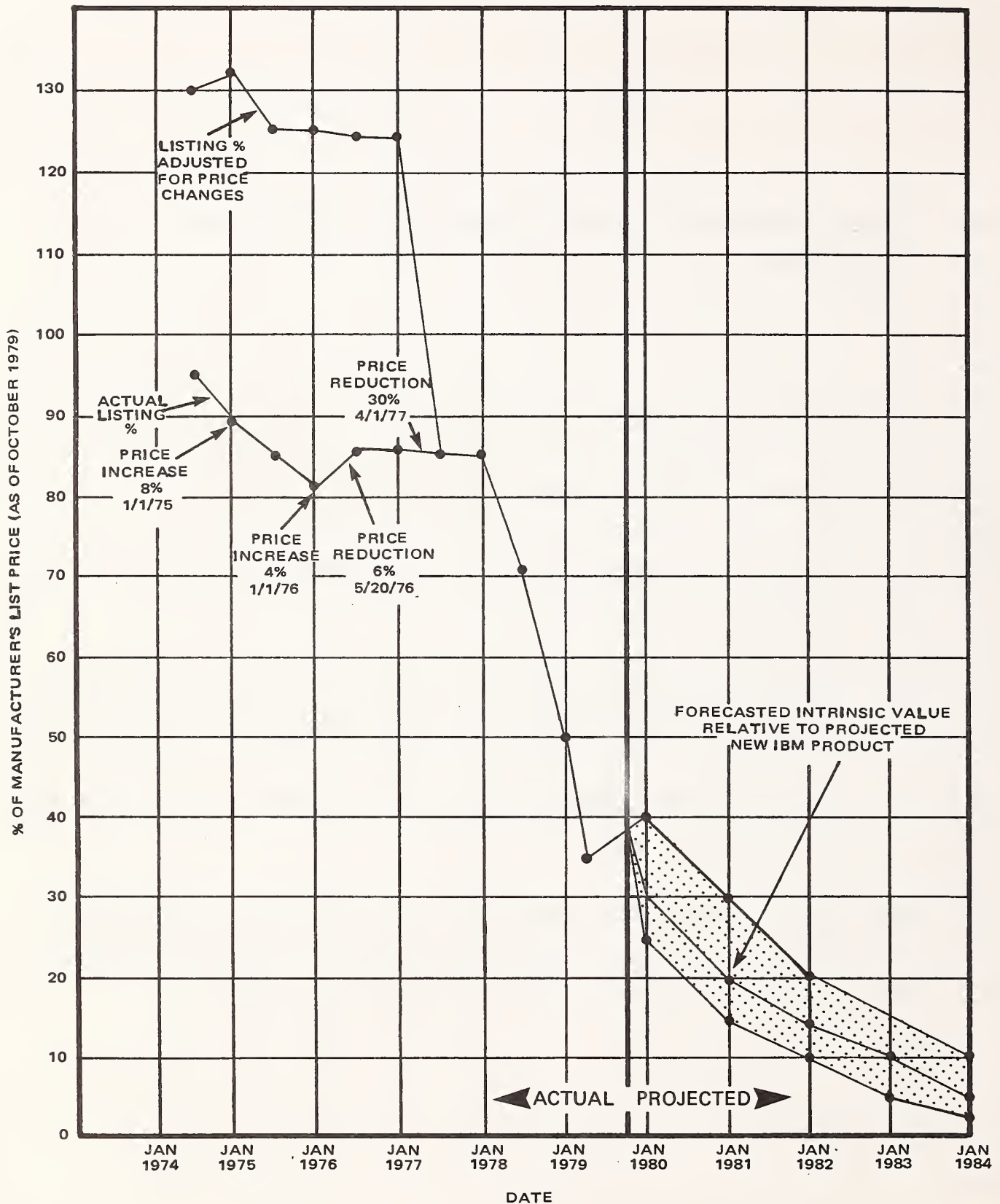


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	40%	30%	20%	15%	10%
EXPECTED	30%	20%	15%	10%	5%
LOW	25%	15%	10%	5%	3%



# EXHIBIT IV-2

## ACTUAL AND PROJECTED WHOLESALE VALUES FOR IBM 370/168-3 PROCESSOR

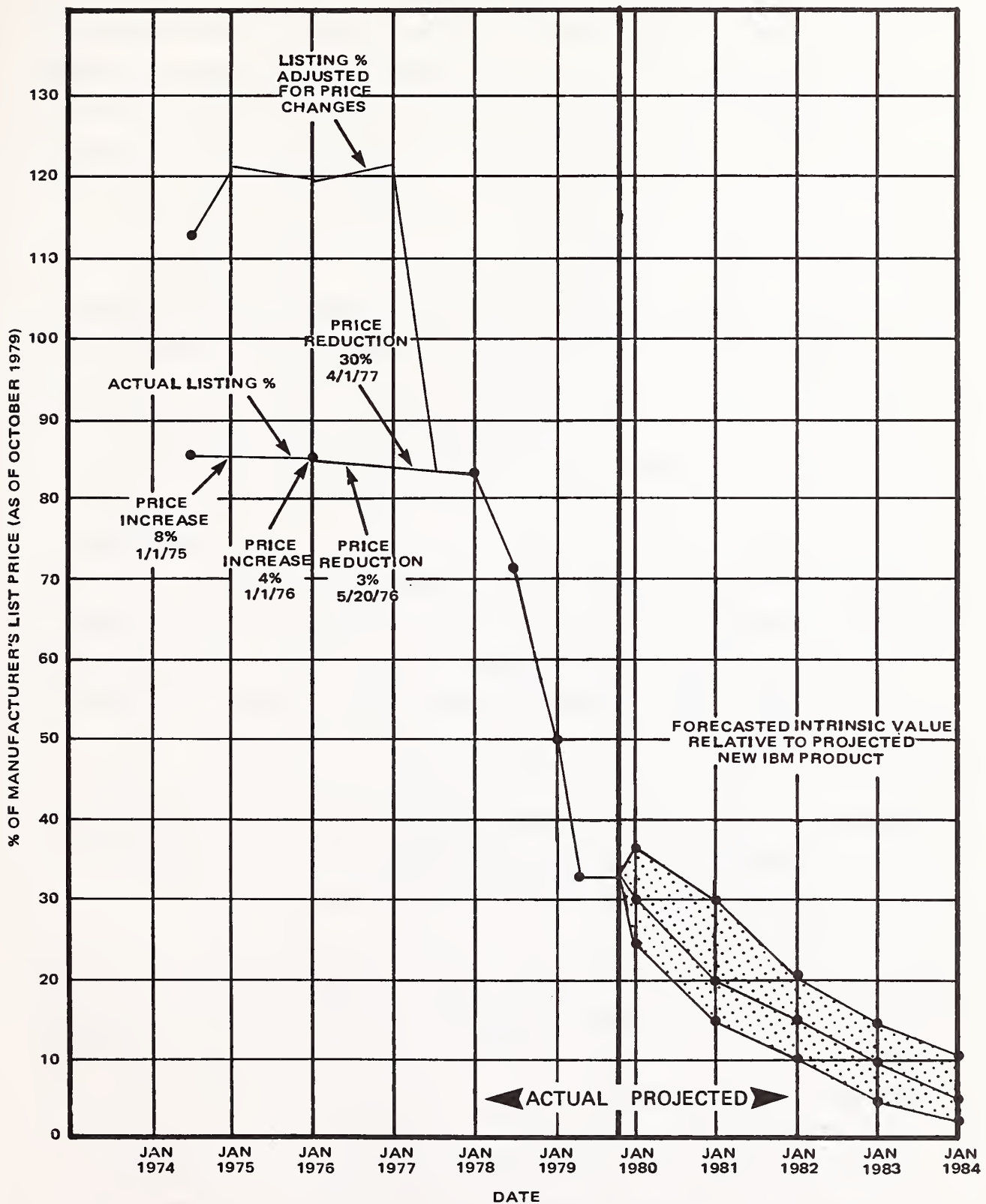


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	35%	30%	20%	15%	10%
EXPECTED	30%	20%	15%	10%	5%
LOW	25%	15%	10%	5%	3%

- The 158-3 forecast remains unchanged from the prior report. There have been no developments which alter the underlying assumptions on which the forecast is based. INPUT does expect, however, a drop in current (October) 158 values to the 30% level by January 1980. We believe IBM will reduce 303X prices and/or announce a new disk product attachable only to 303X CPU's by January, or the expectation of such actions will be so strong as to cause a decline in used market values.
- The projected January 1980, 370/168-3 value has been reset from 33% (March 1979 report) to 30%. This implies a small decline from current (October) values. The impact of actions described above on 168 values will not be as great as on 158s. Few 168s are expected to come on the market by January, which will have a favorable affect on supply/demand relationships.
- A purchase price reduction on 303X CPUs will not have a dramatic impact on 158 and 168 values assuming IBM leaves lease prices unchanged. Presently, almost all trading in 158s and 168s is to acquire CPUs for short-term leasing. The price paid is a function of the expected discounted value of the stream of lease payments. Thus, 158 and 168 values are very sensitive to competing 303X lease rates, and only slightly sensitive to purchase prices.
- The rate of decline for 158s and 168s (also 303X and Amdahl CPUs) in subsequent periods assumes an announcement of the H series by mid-1980 with price/performance characteristics as described in the prior section.
- Presently, we are in a period of very high uncertainty with regard to residual CPU values. Although there are expectations about new IBM processors and also pricing changes on 370 and 303X CPUs, the timing of such actions are pure speculation and may not be known at this time even by IBM itself.
- Likewise, an announcement (from IBM or industry observers) of a lengthy delay in the new product line introduction, such as experienced with the System 38, would have a strong immediate positive impact on used CPU values. This uncertainty is reflected on the projected residual value curves.

- In general, values for 303X and Amdahl processors have been lowered five to ten points from our prior forecasts. This results from a closer examination of the expected impact of differential maintenance and electric power costs when compared to the H Series processors, and a belief that H Series pricing will be slightly more aggressive than originally thought.
- Large 370, 303X, and Amdahl CPUs typically have monthly maintenance costs in the \$8,000-12,000 range, depending on configuration. INPUT projects comparable H Series configurations will have monthly maintenance (for hardware) of \$1,500-\$2,500.
- Residual value forecasts for the IBM 3031 processor are given in Exhibit IV-3 and for the 3032 and 3033 in Exhibit IV-4. It appears that the 303X series has already been discounted by the broker community for expected IBM price reductions. Bids for 303X CPUs would likely be at present in the 65-75% range, depending on configuration and short-term perceived demand. An aggressive IBM price cut (30% or more) would drop values to around 60%. Announcement of 303X mid-life product upgrades and/or significant delays in H Series availability would strengthen used market 303X values.
- INPUT projects January 1980 and January 1984 projected values for 303X processors to be the same. However, we expect the higher end 3032 and 3033 CPU's to fare slightly better than the 3031 in the 1981-1983 time frame. There is less PCM competition in this market, where demand continues to expand fairly rapidly. Users who will have postponed capacity upgrades awaiting H Series, and who then receive unfavorable H Series delivery schedules, will be forced towards the high end 303X (or PCM equivalent) CPUs.
- Because of lagging demand for 3032s, there is some rationale for more aggressive price reductions for this CPU to stimulate activity relative to the 3031 and 3033. INPUT does not project this will happen - but rumors in support of it persist. Should it indeed happen, 3032 values projected on Exhibit IV-4 will tend towards the "Low" figures.

# EXHIBIT IV-3

## PROJECTED WHOLESALE VALUES FOR THE

### IBM 3031 PROCESSOR

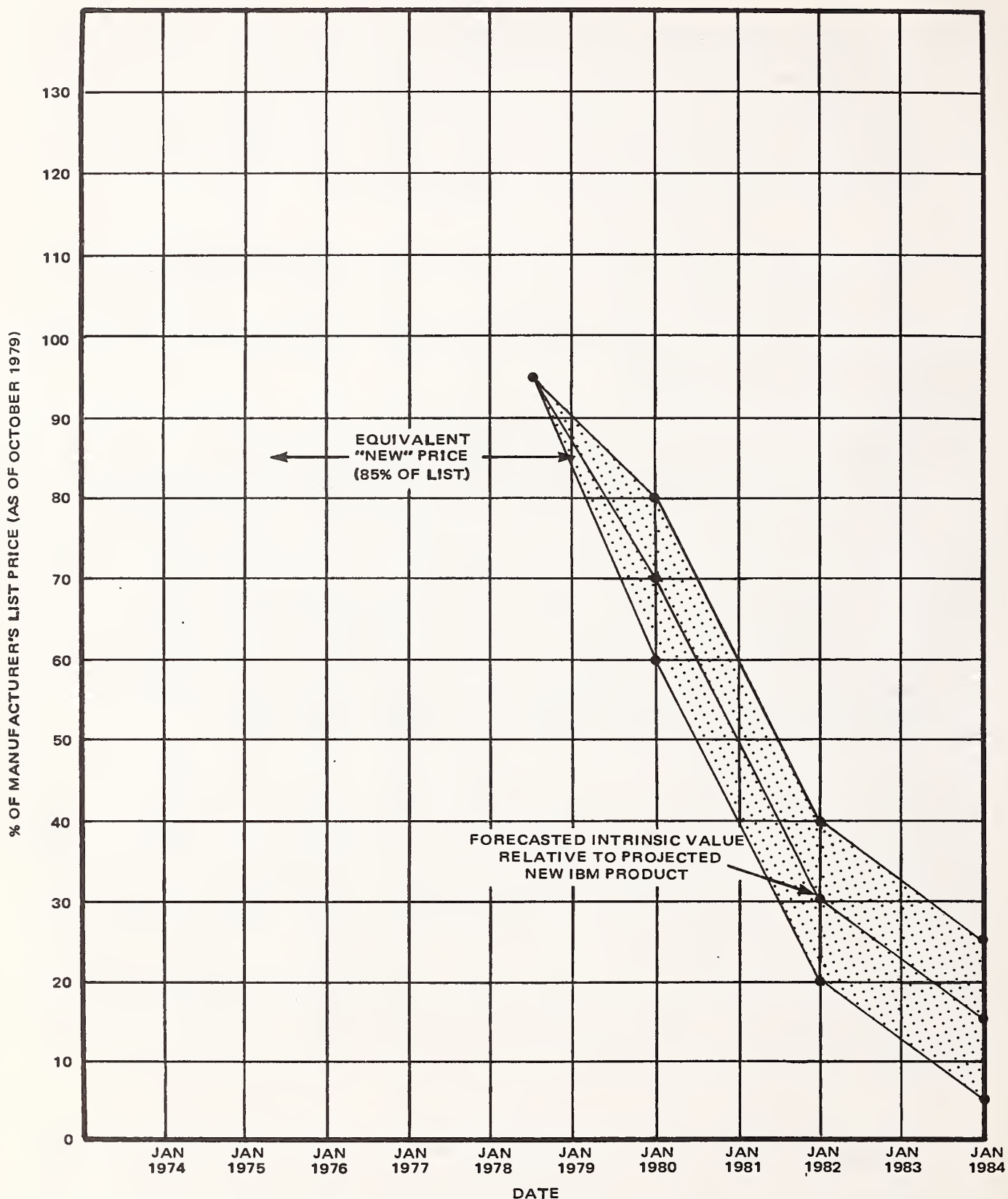


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	80%	60%	40%	33%	25%
EXPECTED	70%	50%	30%	23%	15%
LOW	60%	40%	20%	13%	5%



# EXHIBIT IV-4 PROJECTED WHOLESALE VALUES FOR THE IBM 3032 AND 3033 PROCESSORS

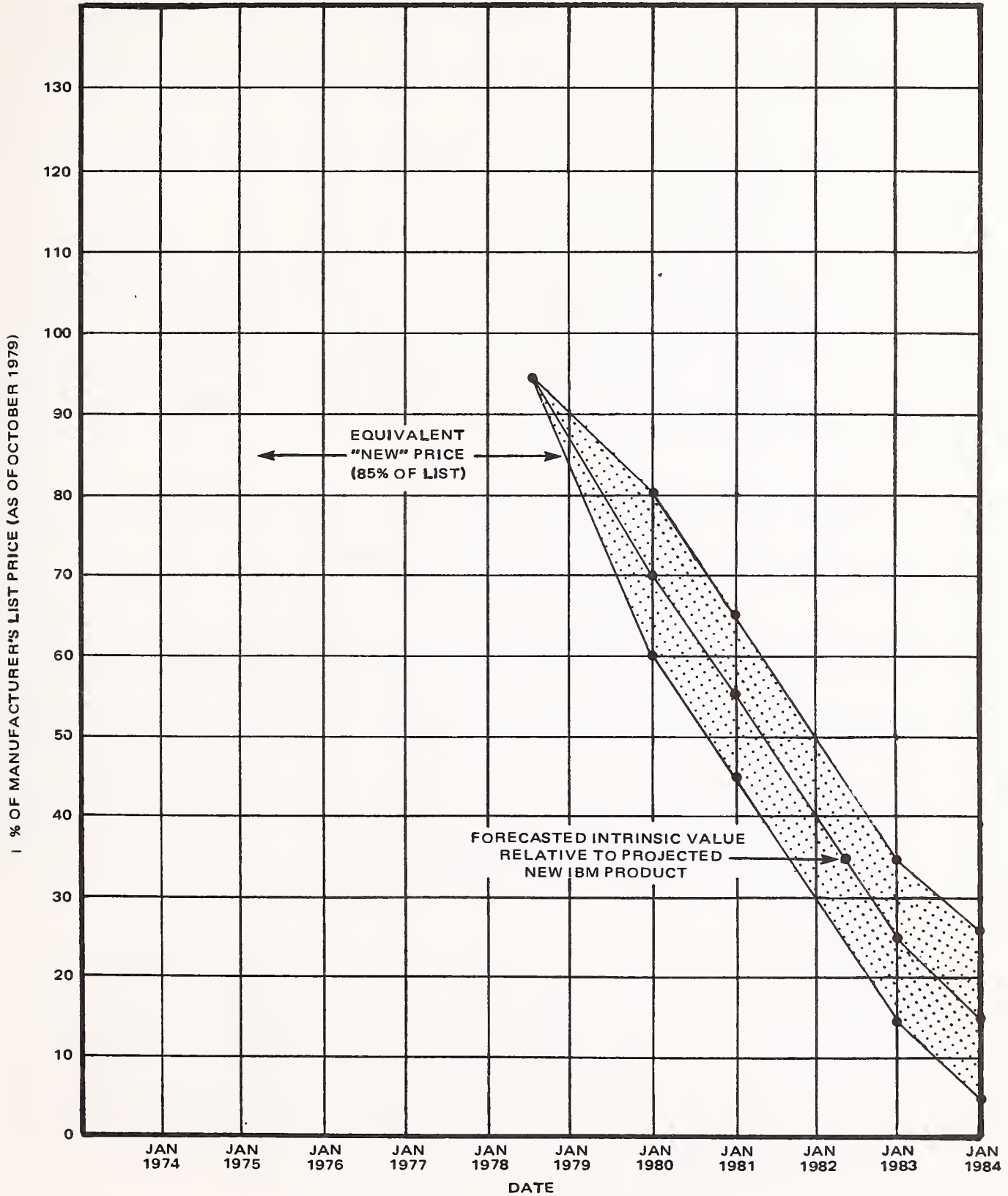


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	80%	65%	50%	35%	25%
EXPECTED	70%	55%	40%	25%	15%
LOW	60%	45%	30%	15%	5%

- Although Amdahl has made efforts to support a secondary market for its CPUs, some brokers who have been involved in used Amdahl transactions have voiced concerns. Whether valid or not, two perceived problems have been:
  - Discounting by Amdahl from list price on V/5 and V/6 CPUs in certain instances.
  - The difficulty is "selling" Amdahl to non-Amdahl sites. Penetrating an IBM site takes special techniques, e.g., visits to Amdahl corporate headquarters for presentations and tours, and then continuing follow-up by Amdahl trained sales representatives. Brokers want to "place," not "sell," a CPU.

The reluctance of some brokers to deal in used Amdahl machines can only have adverse effects on future Amdahl residual values.

- Residual value forecasts for the Amdahl 470 V/5 and V/6 are given in Exhibit IV-5. The V/7 and V/8 projected values are shown in Exhibit IV-6. There are significant architectural differences between the V/6 family (i.e. V/5, V/5 II, V/6, V/6 II) and the V/7 family (i.e., V/7A, V/7, and V/8) which prevent a field upgrade bridge between them. The V/6 family has allegedly seen discounting on new CPUs from list price. There has also been some difficulty in placing used V/6 CPUs by brokers. These factors contribute to lower percent values for V/5 and V/6 processors when compared to their 303X equivalents.
- The V/7 and V/8 series is experiencing firm demand and represents Amdahl's current "state of the art" product line. Thus, INPUT projects stronger residual values as a percent of current list compared to the V/6 family. The V/7 series, with air cooling and technical superiority over IBM's 303X line, is predicated to perform slightly better (as a percent of respective list prices) over IBM's 3032 and 3033 CPUs.
- The uncertainty as to the future of NSC's (ITEL) Data Products group makes residual value forecasting for NSC CPUs at this time just not feasible.

# EXHIBIT IV-5

## PROJECTED WHOLESALE VALUES FOR THE AMDAHL 470 V/5 AND V/6 PROCESSORS

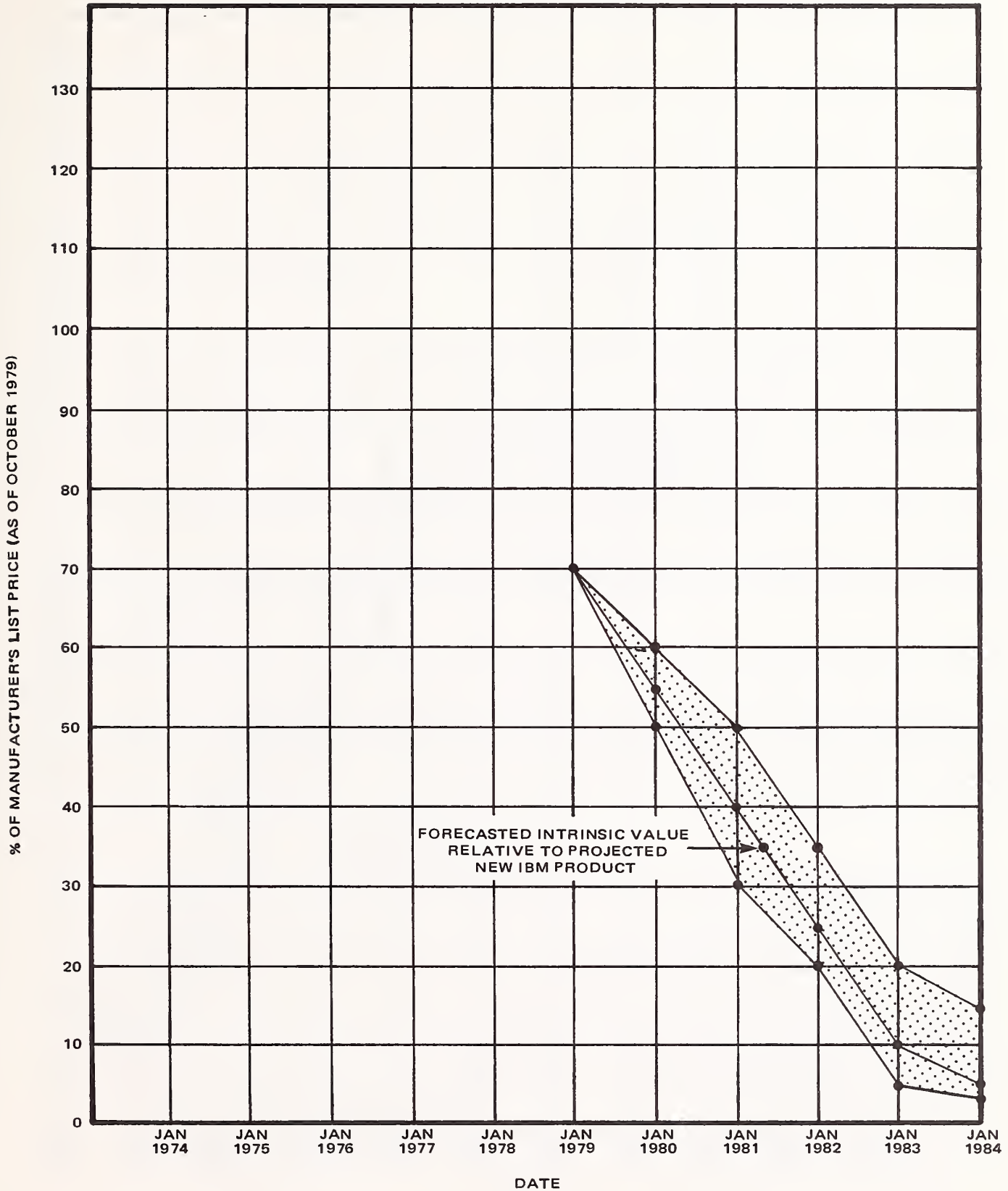
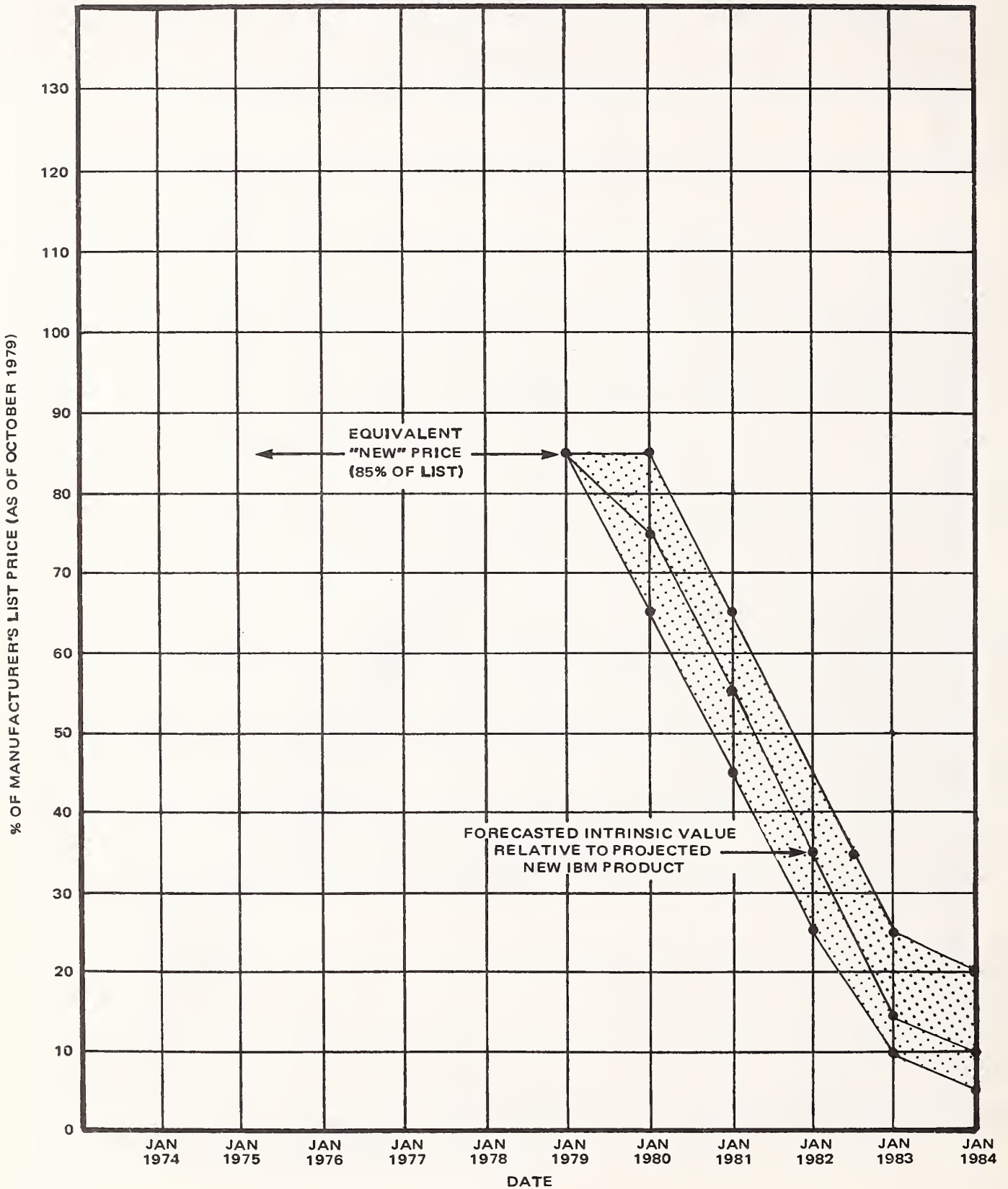


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	60%	50%	35%	20%	15%
EXPECTED	55%	40%	25%	10%	5%
LOW	50%	30%	20%	5%	3%



**EXHIBIT IV-6**  
**PROJECTED WHOLESALE VALUES FOR THE**  
**AMDAHL 470 V/7 AND V/8 PROCESSORS**



**TABLE OF VALUES**

PROJECTED VALUES RANGE	JAN 1980	JAN 1981	JAN 1982	JAN 1983	JAN 1984
HIGH	85%	65%	45%	25%	20%
EXPECTED	75%	55%	35%	15%	10%
LOW	65%	45%	25%	10%	5%

Reports from current NSC installations concerning maintenance and customer support levels are positive. Assuming this continues, we would not expect to see a large influx of NSC CPUs into the used market. However, there are also rumors of a growing inventory of unplaced CPUs which could lead to substantial price cutting from list price. ITEL's policy of "negotiating" a system price with ITEL peripherals, has always made it difficult to know really what "list price" actually meant. Again, it remains to be seen what NSC's pricing policies will be.

- The residual value exhibits identify a point on the curve labeled "Forecasted Intrinsic Value Relative to Projected New IBM Product." These points represent the expected value of the applicable CPU (e.g., Model 370/158 in Exhibit IV-1) relative to its H Series replacement when such replacement is widely available. The intrinsic value is the projected cost of the H Series CPU discounted for features (e.g., ability to attach new peripherals) not available on the "replaced" processor and also adjusted for internal performance differences.
- As indicated in all the exhibits, relative uncertainty concerning these projections is defined by the shaded area above and below the expected value curve. Obviously, the nature and timing of IBM product announcements are significant components of this uncertainty.
- Exhibits IV-3 and IV-4 identify an "Equivalent New Price." This is the price a used CPU would sell for as a percent of list price to compensate for investment tax credit and warranty. The 85% figure is an average figure. The actual value for any given company will range between 80% and 90%, depending upon applicable income tax rate, CPU depreciation period selected, the ability to utilize all ITC generated on equipment acquisition, and whether ITC recapture is later required.



## APPENDIX A: DETERMINANTS OF RESIDUAL VALUE



## APPENDIX A: DETERMINANTS OF RESIDUAL VALUE

- The following discussion applies specifically to large CPUs manufactured by IBM. Residual values for other kinds of computing equipment, including CPUs manufactured by other vendors, although influenced by the analyzed variables, have other dependencies peculiar to each product. Thus, the market characteristics for peripherals and non-IBM CPUs can be very different from that of large IBM CPUs.
- The "plug compatible" CPUs from Amdahl, NSC, and others will, however, parallel IBM's equipment values provided:
  - The firms remain economically and technically strong in the view of the computer industry.
  - IBM software remains available and fully supported.
  - Hardware reliability and maintenance support compares favorably to IBM's.
- Residual value at any given point in the life of a processor is determined primarily by the ability of the device to perform useful work in both current and future time periods. CPUs generally do not wear out in the traditional sense of physical deterioration. Instead they tend to improve in reliability as they age since marginal quality electronic components are continuously weeded out.

- The work the processor can do within a specified time interval is a function of hardware architecture, the efficiency of the software, and the maintenance support applied to both.
- Improvements in CPU architectural design, and trends toward circuit redundancy, better pin layout, and research in improving chip reliability are leading towards products with much lower maintenance and electric power requirements. This can translate into substantial support cost differentials between product generations with considerable impact on residual values.
- Historically, IBM products have had higher resale values than competitive products as a result of market dominance and a larger base of potential buyers rather than an inherent hardware or software product superiority. This relative advantage in value retention is also due to IBM's excellent maintenance policies. For example, a purchaser of IBM used equipment normally receives a guarantee that:
  - The equipment is working to specifications.
  - IBM Maintenance support will be available following transfer of title (assuming the equipment has been under continuous IBM maintenance).
  - The purchaser can thus expect the used equipment to perform as well as (perhaps better) than new equipment from the manufacturer.
- In recent years a major broker industry has developed, oriented around the buying and selling of used computers. As with other brokerage operations, used computer prices are sensitive to supply and demand conditions within the market at any given time.
- These short-term fluctuations fall generally within a range of "perceived value," which is a function of the price/performance ratios of alternative equipment choices and also expectations about future technology or pricing changes.



- Historically, the dominant factor influencing used computer values has been the actions of IBM. Its pricing and maintenance policies on old equipment, coupled with the price/performance of new products, have had a direct effect on used equipment values.
- As long as IBM dominates the market, it is likely that these values will be predictable on the basis of prior action.
- However, the various external forces which influence IBM actions are undergoing change. Influencing factors may be results of:
  - Anti-trust litigation.
  - The success of "plug compatible" CPU suppliers such as Amdahl and now NSC.
  - Foreign competition in U.S. and world markets.
  - Trends toward distributed computing.
  - New technological developments.



APPENDIX B: HISTORICAL VALUE PATTERNS FOR  
USED IBM PROCESSORS



## APPENDIX B: HISTORICAL VALUE PATTERNS FOR USED IBM PROCESSORS

- The residual values of IBM processors have followed fairly consistent patterns. During the first two to four years following introduction, used CPUs offered in the market have sold for essentially new list price. This price was discounted by 10-15% because of tax benefits relating to new equipment purchase (the Federal investment tax credit) and also for the warranty provided on new equipment. After this initial period, values have declined at 5-15% per year. The rate of decline has been a complex function of the many variables listed in Exhibit B-1.
- First with the 370/138 and 370/148, and subsequently with the 303X and 43XX processors, IBM introduced products with two to three times the price/performance of existing CPUs. This has caused an accelerated decline in residual values (compared to prior periods) such that the 15%/year figure has in recent years been the more typical case.
- The exact value of a processor, at any given time, is dependent on the supply/demand relationship within the market at the time the user wants to buy or sell his CPU. Sellers have in the past often created an illusion of "over supply" by listing with dozens of brokers, a practice which ultimately affected adversely their selling price.

## EXHIBIT B-I

### VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

#### I. IBM PRACTICES AND POLICIES

##### a. New Product Announcements

- Price/performance ratios relative to existing products.
- Ease of conversions, transitions, and lead time in obtaining new products.
- Ease of installation and maintenance.
- Affect on perceptions of IBM's technical direction.

##### b. Pricing Policies

- Price increases or decreases on existing products.
- Rental vs. purchase breakdown ratios.
- Lease plans and penalty provisions for lease termination.
- Purchase option accruals.

## EXHIBIT B-I (CONTD)

### c. Maintenance Policies

- Availability and cost.
- Attitude toward other vendor modification of CPU to enhance function or speed.

## 2. ALTERNATIVE CPU SOURCES

### a. Price/Performance of Non-IBM Manufactured CPUs

- The impact of plug compatible mainframes (Amdahl, NSC, etc.) is significantly greater than the impact of other CPU manufacturers (e.g., CDC, Honeywell, etc.)

### b. Third Party Leasing Companies

- Pricing policies for both CPUs and mixed, multi-vendor "systems."
- Inventory situation - many of the same companies are active in both buying and selling in the used market.

## 3. OTHER VARIABLES

### a. Tax Considerations

- Income tax incentives such as investment tax credit and accelerated depreciation.
- Property taxation.



## EXHIBIT B-I (CONTD)

### b. General Economic Conditions

- Cost and availability of capital.
- Overall demand for new and used equipment.

- Used IBM large processor prices underwent a relatively steep decline during 1974, as the System/370 Model 158 and the System/370 Model 168 with VS software entered the market. This decline in used computer prices, with systems selling for less than their intrinsic value, was reversed in early 1975. Most used computer prices then increased for a sustained period of time.



APPENDIX C: ANALYSIS OF VARIABLES AFFECTING  
VALUES OF USED IBM COMPUTERS



## APPENDIX C: ANALYSIS OF VARIABLES AFFECTING VALUES OF USED IBM COMPUTERS

- The variables in Exhibit B-I can be classified into two categories:
  - Some variables affect the intrinsic value of an installed CPU (e.g., the price/performance ratio of new product announcements). The 370/168-3 CPU has very similar performance characteristics to the 3032, however, the pricing is quite different (see Exhibit III-1). The value of the 370/168-3 should, therefore, closely follow the price of the 3032 - as long as the two CPUs are perceived to be essentially equivalent.
  - Other variables affect the supply/demand relationship in the market-place (e.g., the lead time in obtaining new products). The demand for processing power was much greater than suppliers could provide following the 3032 product announcement. The 370/168-3's actual value was, therefore, considerably higher than its intrinsic value because a supply of the lower cost alternative was not available.
- Some products, such as the IBM 3211 printer, are introduced with little or no price/performance advantage over existing products. Therefore, the 1403 printer maintained a high residual value.
- The 370/138, 370/148, and 303X series processor announcements, on the other hand, incorporated better than two-to-one price/performance ratios over 370/125, 370/145, 370/158, and 370/168 processors. This dramatic drop in

price/performance curves (relative to prior processor announcements) caused a sharp decline in installed 370/135, 370/145, 370/158 and 370/168 market values.

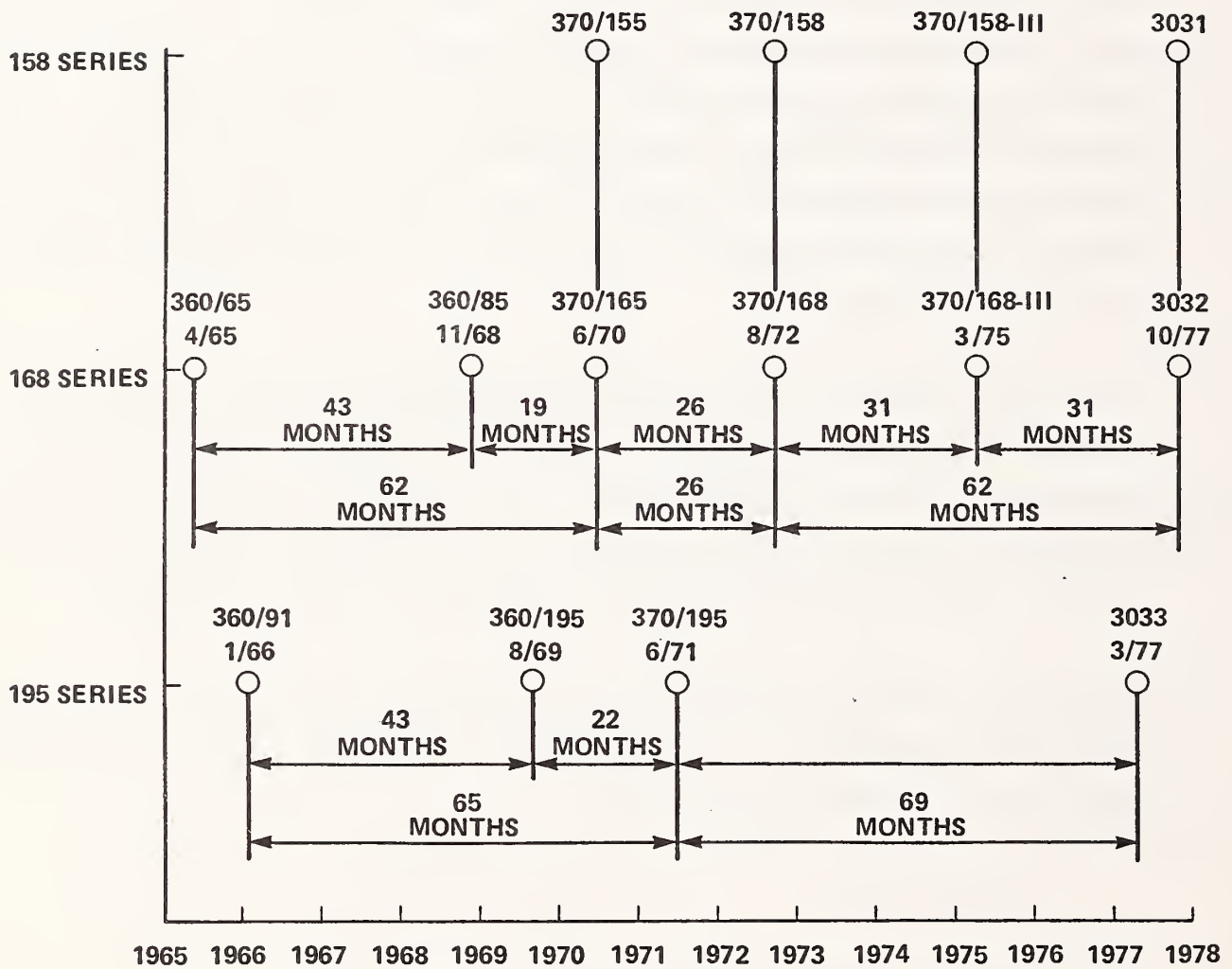
- Transition to newer technology requires consideration of both software and hardware factors. Although computer manufacturers strive for software compatibility between "generations," some program modifications are almost always required.
- Trends toward more compact packaging of the CPU and related components and reduced cooling requirements have simplified physical space planning for most new hardware installations. There may, however, be special requirements, such as the 370/168, 3032, and 3033 440 cycle power and internal chilled water cooling, which necessitate costly site preparation expenses.
- Lead times in obtaining new products can vary from a few months to years. There are two significant time intervals to be considered:
  - The time interval from product announcement until the first installations begin (thus, when "replaced" equipment enters the used market).
  - The time interval between announcement and when a given customer is scheduled for installation. That given customer may become a buyer in the used market if the new product is not available in time to meet his expanding requirements, or he may attempt to purchase an earlier delivery position from another customer, usually by paying a premium over the manufacturer's list price.



- New product announcements are generally analyzed in considerable detail. Consultants and other industry experts provide opinions on what the impact of the new product will be on current markets and, when appropriate, what new technological change the product portends. This tends to define the degree of technological obsolescence applicable to existing products. Exhibit C-1 provides announcement dates for the 370/158 series, 370/168 series, and 370/195 series CPUs.
- Price increases by the manufacturer have tended to stabilize the used market, while price decreases produce an opposite effect. In any event, both are generally passed through rapidly to the used computer market. Used equipment is normally listed as a percentage of the current new price, and this percentage has tended not to change when vendor list prices have changed. Exhibit C-2 shows the frequency and magnitude of price changes for 370/158 and 370/168 processors.
- The consent decree of 1956 altered IBM's rental-only policy and was the primary force in establishing the used computer industry. IBM has gradually changed the relationship between rental and purchase prices in a manner which encourages purchase, thus increasing the potential disruptive effect caused by the large number of units available to be traded in the used marketplace.
- Leasing plans offer yet another financing alternative when equipment changes are under consideration. The amount of the lease discount over short-term rental rates is normally a function of:
  - The lease term.
  - Penalties for early termination.
- When contemplating early termination, it may be advantageous to sell the equipment in the used market rather than pay penalties. This depends on the amount of the penalties and the differential between the used market value and purchase cost, including accrued purchase option credits.

# EXHIBIT C-I

## ANNOUNCEMENT DATES FOR 370/158 SERIES, 370/168 SERIES AND 370/195 SERIES CPU S



## EXHIBIT C - 2

IBM PRICE CHANGES FOR 370/158 AND 370/168 PROCESSORS  
(FOR PROCESSORS WITH 2 MILLION BYTES OF MAIN MEMORY)

IBM CPUs	INITIAL PRICE	1/1/75 PRICE	1/1/76 PRICE	5/20/76 PRICE	4/1/77 PRICE
370/158 (4/73 1st INSTALL) (% CHANGE)	\$1,999	\$2,159 (8%)	\$2,245 (4%)	\$2,105 (-6%)	\$1,460 (-31%)
370/168 (8/73 1st INSTALL) (% CHANGE)	\$2,898	\$3,130 (8%)	\$3,255 (4%)	\$3,162 (-3%)	\$2,204 (-30%)

(\$000)

- The ability to sell accrued equity in equipment which has been under lease or rent has substantial impact on used equipment values. The monthly percentage decline in purchase price due to purchase option accruals is shown for 370/158, 370/168 and 303X series processors in Exhibit C-3. IBM policy is to apply accruals against current price lists, normally to a maximum of 50%.
- The 30% or more price reduction on 370/158 and 370/168 processors on 4/1/77, immediately placed many rented and leased units at the 50% maximum accrual position. As long as the market value remains above 50%, a user who is renting a 370/158 or 370/168 which is no longer needed can exercise the purchase option, then sell the CPU for a profit.
- The availability of competent maintenance support at a reasonable cost is a critical factor in establishing the value of a used computer. IBM's policy of guaranteeing maintenance support, regardless of ownership, has enhanced IBM residual values relative to other vendors.
- The life (and thus value) of a used computer can be extended by capacity enhancements. Such capacity enhancements have been provided by IBM (e.g., the Model 3 upgrade for 370/158 and 370/168 processors) and also by the independent vendors, most notably by increasing main memory size over IBM-supported levels.
- Improvements in function or performance made to IBM CPUs by other vendors are viable only if IBM maintenance support to the base systems is not adversely affected.
- Third party leasing companies provide attractive (relative to IBM pricing) lease rates for IBM equipment. Penalty provisions normally exist and produce consequences similar to those discussed above for IBM leases. The packaging of non-IBM peripherals with an IBM CPU also provides a "total system" alternative at substantial price discounts.

### EXHIBIT C - 3

#### MONTHLY DECLINE IN PURCHASE PRICE DUE TO PURCHASE OPTION ACCRUALS WHEN RENTING FROM IBM UNDER MONTHLY RENTAL CHARGE (MRC) PLAN

CPU (4 MEGABYTE)	ACCRUAL RATE	% BEFORE 4/1/77 PRICE REDUCTIONS	% AFTER 4/1/77 PRICE REDUCTIONS	MAXIMUM ACCRUAL	MONTHS TO REACH MAXIMUM ACCRUAL	PURCHASE/ MRC RATIO
370/158	55%*	1.12%	1.50%	50%	31.6	31.7
3031	55%	—	1.63%	50%	30.7	33.8
370/168	55%*	1.07%	1.48%	50%	32.1	32.1
3032	55%	—	1.47%	50%	33.9	37.3
3033	50%	—	1.15%	59%	36	43.8

\*50% if under IBM Term Lease Plan



- Disposal of large inventories of used processors (or the threat of this) can influence short-term supply and demand conditions within the market and thus impact used equipment value.
- The investment tax credit is normally available only on new equipment. Used equipment prices are thus discounted by at least the after-tax value of this credit. Other tax implications, such as allowable depreciation, must also be considered for any given transaction.
- Property taxes are related to the assessed value of the equipment. The lower taxation burden on used equipment alternatives can be a significant factor in the procurement decision.
- Although computers generally represent a very significant capital expenditure, the computer industry has been less sensitive to economic recessions than most other industries. Recessions will tend to dampen overall demand, but on the other hand, less costly used equipment alternatives become more attractive during periods of fiscal belt-tightening.
- Holding on to used equipment for too long has certain less tangible drawbacks. For example:
  - Programmers don't like working with obsolete equipment; therefore, the best and the most productive leave.
  - Conversion costs, when skipping a generation or two, can be very expensive.
  - "Quantum jumps" in sophistication of systems can cause severe problems because of the lack of qualifications and capabilities of existing staff to cope with them.







**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Small Establishments Service - Analyzes and forecasts small establishments' (<500 employees) use of office, communication, and computer services and products. Applications requirements and economics and emphasized.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$50,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1978 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have over 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2471 East Bayshore Road  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
Empire House  
414 Chiswick High Road  
London, W4 5TF  
England  
995-5397/8/9  
Telex 896739

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

U-RV 6

RESIDUAL VALUE FORECASTS  
FOR PRINTERS

MARCH 1980



## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts - Four reports providing detailed five-year forecasts of residual values of major computer mainframe and peripheral equipment.
- Vendor Watch Reports - Six reports which analyze the probable moves of major computer/communications vendors in operating systems, DB/DC software, mainframes, value added networks, mass storage, and other areas.
- EDP and Communications Planning Report - Contains analyses and composite forecasts of both short and long-term plans of computer/communications users. Includes operating ratio data.
- Impact/Technology Reports - At least three in-depth analyses of the impact on users of projected technological, managerial, and personnel developments over the next five years.
- Conferences - National conference for all clients held at a convenient location in November. Local and regional conferences held according to client interest.
- Consulting Support - Individual consultation with research staff on an as-needed basis through telephone inquiries and visits.
- Presentations - INPUT staff makes general or specific presentations to client management or staff at client's location.

**RESEARCH METHOD:** INPUT carries out extensive research in computers, communications, and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are based on the judgement of INPUT's staff.
- Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ -7662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Road  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600

U-RV 6

RESIDUAL VALUE FORECASTS  
FOR PRINTERS

MARCH 1980





# RESIDUAL VALUE FORECASTS FOR PRINTERS

## TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION .....	I
II PRINTER TECHNOLOGY REVIEW .....	3
A. Impact Printers	3
B. Non-Impact Printers	4
III COMPETITIVE PRODUCTS AND FUTURE TRENDS	9
A. IBM High Speed Printers	9
B. Competitive Printers	10
C. Trends In Printer Technology	13
IV RESIDUAL VALUE FORECASTS FOR IBM 1403NI, 3211, AND 3800 PRINTERS	17



## RESIDUAL VALUE FORECASTS FOR PRINTERS

### LIST OF EXHIBITS

		<u>Page</u>
II	-1	Typical Characteristics Of Impact Versus Non-Impact Printers
		7
III	-1	Characteristics Of Page Printing Systems
		12
IV	-1	Price History Of IBM 1403NI, 3211, And 3800 Printers
		19
	-2	Residual Value Forecast For IBM 1403NI Printer
		20
	-3	Residual Value Forecast For IBM 3211 Printer
		21
	-4	Residual Value Forecast For IBM 3800 Printer
		23



## I INTRODUCTION



## I INTRODUCTION

- This report on IBM high speed printers is issued as part of the Residual Value Forecast series in INPUT's Planning Service for Computer and Communications Users. This report and others to be issued in the future on peripheral product lines are intended to complement the basic program which produces residual value forecasts of large IBM and plug compatible mainframes at six month intervals.
- The purpose in creating these reports is to provide information useful when evaluating computer equipment acquisition alternatives. It is INPUT's intent not to provide an in-depth technical analysis of a selected computer peripheral area, but rather to provide some very general information about the technology, a review of key issues, and some specific residual value forecasts on selected equipment items.
- The subject of this report is IBM high speed printers. Residual value forecasts for the IBM 1403 NI, 3211, and 3800 printing systems are presented in part IV of the report.
- The factors which influence and therefore are taken into account in projecting residual values are discussed in parts II and III. Part II provides a general overview of the various technologies utilized in producing printers. Part III reviews competitive products and discusses trends which will influence future market values.



- The peripheral areas selected by INPUT for analysis is directly related to information provided by subscribers to the Planning Service for Computer and Communications Users. Your ideas and suggestions are welcomed. The next report in the peripheral series will update and expand upon our June 1979 report on high capacity disk storage systems. Topics for subsequent reports have not yet been decided upon and will be based on preferences expressed by our subscribers.

## II PRINTER TECHNOLOGY REVIEW



## II PRINTER TECHNOLOGY REVIEW

- The spectrum of printer technologies and related output speeds is very broad. It ranges from serial character impact printers producing a few characters per second to laser based page printers with speeds in excess of 20,000 lines per minute. This section describes briefly some of the technologies utilized in printer manufacturing.
- Computer output printers are usually designated as either impact or non-impact devices. Some of the tradeoffs between the two categories are discussed in this chapter. Also described is a hybrid approach with characteristics of both which is expected to be a viable product within 18 months.

### A. IMPACT PRINTERS

- Impact printers strike an inked ribbon with some object, thereby transferring ink in some image form to the paper. The character representation is created either by the striking object being a fully formed character (i.e., a character printer) or by a pattern of dots (i.e., a dot matrix printer).
- Examples of character impact printers are the selectric typewriter, daisy wheel printers such as those produced by Diablo and Qume corporations, and line printers such as the IBM 1403 and 3211. They require a mechanical mechanism (sometimes quite complex) to strike the ribbon against the paper.

- Dot matrix impact printers create characters by "firing" selected wire pin combinations. This leaves dots of ink where the pins have struck the ribbon against the paper. Each character is defined by a unique pattern of dots. For a given character size and dot diameter, increasing the number of dots per character will improve image definitions, or the perceived "quality" of the printing.
- Wire matrix printers have one major advantage over printers using fully formed characters. The character descriptions are digitized in memory, and thus there is no theoretical limit to the number of characters that can be created. Signatures, logos, or other special images can also be generated, but this of course requires programming effort.
- Sanders Technology recently introduced what it calls the infinite matrix printer. Its media 12/7 printer can place a 13-mil dot anywhere on a page to within 1-mil accuracy. The printer can produce one pass "draft" quality documents at a speed up to 216 characters per second (cps). When final copy is wanted, multiple passes are made with the dots overlapping to produce much higher quality (but at a reduced output speed of 30-45 cps).

## **B. NON-IMPACT PRINTERS**

- Non-impact printers typically utilize ink jet, laser, thermal, or electrostatic technologies. Ink jet has proven difficult to develop, and thus there are only a few products on the market. The best known is the IBM 6640 printer available from IBM's Office Products Division.

- Ink jet printers shoot a very fine stream of electrically charged ink droplets onto paper. The modulated stream is deflected horizontally in much the same manner as an electronic beam in a cathode ray tube. The droplets form dot patterns as the paper moves vertically. Character descriptions, defining where the dots are placed to form the appropriate character, are stored digitally in the printer's computer memory.
- The IBM 6640 ink jet printer can shoot up to 117,000 droplets of ink each second, which produces 184 cps (12-pitch characters) in draft mode, or 92 cps in final copy mode. IBM has installed over 6,000 of the 6640 printers.
- Laser printers follow the same principle; i.e., a modulated beam is swept across a vertically moving surface. In this case, the beam is light from a stationary laser. The sweeping effect is created by a revolving mirror. The moving surface is a light sensitive media, typically an electrostatically charged rotating drum. Patterns of "charged" and "discharged" areas are created on the drum. The charged areas pick up toner which is then transferred onto paper and fused by heat.
- Thermal printers require specially treated heat sensitive paper. The paper changes color where heated wires in print-heads make contact, forming dot matrix characters. Speeds up to 500 lpm have been achieved in commercial printer-plotter systems. This technology is most widely used, however, in portable computer terminals.
- Electrostatic printers also require specially treated paper. The Honeywell Page Printing System, described more fully in the following section, uses this technology. A coated dielectric paper moves past a horizontal row of metal stylus to which voltages are selectively applied. Each voltage application to a given styli creates a charged spot on the paper. Toner is applied which is attracted to the charged areas, thereby creating the dot matrix characters.
- An interesting hybrid approach having characteristics of both impact and non-impact printers is under development by Centronics Data Computer Corpora-

tion using technology obtained from Olivetti Corporation. The device, called the Quietwriter, uses a servo-controlled stylus to draw characters through a typewriter ribbon. Thus, the unit takes digitized characters (stored within plug-in modules) and converts the digital signal to an analog output via voice coil actuators. Like non-impact printers, the Quietwriter has low noise levels and digitized characters. Like impact printers, characters are created by pressing an inked ribbon against paper, allowing multiple copy capability.

- Exhibit II-1 provides a comparison of the primary differences between impact and non-impact printers.



# EXHIBIT II-1

## TYPICAL CHARACTERISTICS OF IMPACT VERSUS NON-IMPACT PRINTERS

CHARACTER- ISTIC	IMPACT PRINTER	NON-IMPACT PRINTER
PAPER	GREATER FLEXIBILITY - CAN USE MULTI-PART AND MULTI-COLOR PREPRINTED FORMS	GENERALLY USE ROLL, FANFOLD, OR CUT SHEET PAPER. A FORMS GENERA- TION CAPABILITY MAY BE AVAILABLE. CERTAIN NON- IMPACT PRINTERS RE- QUIRE SPECIALLY TREATED PAPER.
INKING	USE RIBBON	USE TONER
SPEED	UP TO 3,800 LINES PER MIN- UTE, ALTHOUGH COMPAR- ATIVE OUTPUT CAN BE GREATER DUE TO ABILITY TO SKIP OVER BLANK LINES AT RATES UP TO 100 INCHES PER SECOND.	UP TO 20,000 LINES PER MINUTE WITH DENSE PRINTING (i.e. 12 LINES PER INCH). THE PAPER MOVES AT A CONSTANT SPEED (UP TO 30 INCHES PER SECOND)
QUALITY	GREATER VARIABILITY AS QUALITY IS SENSITIVE TO RIBBON CONDITION, NUM- BER OF COPIES, MECHAN- ICAL ADJUSTMENT, AND METHOD OF CHARACTER GENERATION.	MAINLY A FACTOR OF CHARACTER RESOLUTION (i.e. NUMBER OF DOTS PER INCH).



### III COMPETITIVE PRODUCTS AND FUTURE TRENDS



### III COMPETITIVE PRODUCTS AND FUTURE TRENDS

- This section will briefly review the evolution of the IBM high speed printer line (1403 to 3211 to 3800), discuss some of the competitive products to these printers, and examine some trends expected to influence future residual values.
- In this section, frequent reference will be made to printer speeds. For 1403 or 3211 line printers - which use fully formed characters on trains, chains, bands, etc. - the output speed is dependent on the size of the character set. Unless otherwise indicated, line per minute (lpm) rated speed assumes the commercial 48 character set.

#### A. IBM HIGH SPEED PRINTERS

- The 1403 printer series (there are several models but only the 1100 lpm NI model presently is in widespread use) was introduced in 1964. This printer announcement was part of the IBM 360 computer product line introduction which included new disk, tape and unit record products as well. The 1403 printer is the only major product of that era is attachable to IBM's newest computer family - the 4300 series.
- The IBM 3211 printer was announced in October 1969. Relative to the 1403, it offered a higher printing speed (2,000 lpm vs. 1,100 lpm) but little else. Upon

introduction, it provided a very slight price/performance advantage over the 1403 product. Since that time, the 3211 printer has declined in price by 30%, while the 1403, after a price reduction in 1971, has increased in price by 18% (see Exhibit IV-1). This strategy was clearly designed to shift customer acquisition decisions for line printers toward the newer 3211 product.

- The IBM 3800 printing subsystem for most printing applications does not offer a significant price/performance advantage over the 3211. It does provide much improved image quality and, with its digitized character sets, flexibility in the number and intermixing of type fonts. This flexibility, however, is extremely limited when compared to even the most inexpensive phototypesetters.

## **B. COMPETITIVE PRINTERS**

- The plug compatible products for IBM's 1403 and 3211 printers typically provide modest improvements in features and performance at moderately better prices. Some of the vendors in this market are:
  - Control Data Corporation. The CDC 1403I and 3211I printer systems offer very similar operating characteristics at 85-87% of the price of their IBM equivalent counterparts (as of January 1980). The CDC machines do offer improvements in character buffering and in vertical format control.
  - Decision Data. This firm offers a series of 1403 plug compatible printers. There are drum printers with rated speeds of 200, 300, 450, 600, and 900 lpm and a 1,500 lpm band printer.
  - Documation. There are currently ten different Documation models ranging in speed from 1,000 lpm to 3,800 lpm. They cleverly assign the model number equivalent to the rated lpm speed of the device. The



newer "3000" series (models 1550, 1800, 2250, 2600, and 3000) come as either 1403 or 3211 plug compatible, and are field upgradable (i.e., the 1550 or others in the series can be upgraded to the 3000).

- The plug compatible competitors to IBM's 3800 printing subsystem are Honeywell's Page Processing System, National Advanced System's (formally Intel's) 7800 Laser Printer, and the Xerox 9700 Electronic Printing System. Exhibit III-1 provides a brief overview of these products.
- Documation is expected to enter the high speed laser printer market with a product presently named "Laserpage." It may be introduced at the National Computer Conference in May 1980.
- Honeywell was the first entrant in the high speed page printing area. In 1974, the Page Printing System (PPS) was announced - an off-line page printer with 90, 140, and 210 pages (8½ x 11 inch) per minute models. A follow-on product, the Page Processing System (PPS-II), appeared in June 1979. This product added on-line operation, digital forms generation, and software loadable type fonts.
- National Advanced Systems (owned by National Semiconductor) markets a 3800 look alike manufactured by Siemens called the 7800 Laser Printer. The unit is more similar to the 3800 in functional and operating characteristics than the Honeywell or Xerox products. The Siemens' unit is engineered with a shorter paper path than the 3800 and photoconductive material requiring less frequent replacement.
- The Xerox 9700 Electronic Printing System uses the 9200 duplicator as its printing engine. Two recently announced optional features are two-sided printing and microfiche production. The machine prints on 8½ x 11 inch cut sheet paper in either portrait or landscape mode. A DEC PDP 11/34 computer system provides intelligence for systems control and disk storage capacity for digitized character sets and forms descriptions. The relatively higher resolution (and thus image quality) and variable type size (presently from 24



EXHIBIT III-1

CHARACTERISTICS OF PAGE PRINTING SYSTEMS

CHARACTERISTIC	IBM 3800	NAS 7800	HONEYWELL PPS-II	XEROX 9700
PAPER TYPE	FANFOLD	FANFOLD	ROLL - ELECTRO-GRAPHIC	CUT SHEET
RESOLUTION - DOTS / INCH	144 X 180	144 X 180	200 X 200	300 X 300
EFFECTIVE OUTPUT SPEED IN INCHES / SECOND	27	29	30	22
FORMS HANDLING	FORMS FLASH	FORMS FLASH	DIGITAL CODING	DIGITAL CODING
COST (ON-LINE VERSION EXCLUDING PER COPY CHARGES)	\$341,750	\$270,000	\$237,600	\$295,000
SPECIAL FEATURES	1.OPTIONAL BURST-ER - TRIMMER-STACKER	1.OPTIONAL BURST-ER - TRIMMER-STACKER	1.SEVERAL MODELS WITH VARYING SPEEDS AVAILABLE 2.OPTIONAL COLLATOR WITH UP TO 32 BINS	1. VARIABLE TYPE SIZE FROM 4 TO 24 POINTS 2. SAMPLE OUTPUT TRAY 3. OPTIONAL TWO-SIDED PRINTING 4. OPTIONAL MICRO-FICHE CAPABILITY

points to 4 points) of the 9700 have resulted in interest from the printing industry. The 9700 is viewed as a significant step toward on-line electronic printing which can compete with in-plant press operations (phototypesetter and offset presses).

### C. TRENDS IN PRINTER TECHNOLOGY

- Two trends expected to affect IBM 1403, 3211, and 3800 future residual values are:
  - The proliferation of moderate cost (\$10,000 - \$100,000) laser driven printers with communication interfaces permitting location at end user work sites.
  - The development of high speed electronic printers with sufficient function to eliminate the need for conventional in-plant press operations.
- A few moderate cost laser based printer products built around copier engines are now available. The Wang image printer (about \$32,000) uses the Konishiroku copier (marketed in this country as the Royal Bond Copier II). The IBM 6670 information distributor (\$75,000) uses the IBM Series III, Model 10 copier unit. Canon recently introduced the LBP-10 semiconductor laser beam printer -a desk top unit which is attractively priced (about \$10,000) but presently lacks a computer interface (although work is in progress to develop such an interface at several sites, including Stanford University, where work is almost completed on a microcomputer based RS232 compatible interface which would permit user defined character sets).
- Xerox will soon provide xerographic laser printers based on its 3400 and 5400 copiers. These products will link to Xerox's recently announced Ethernet, a high band width coaxial cable local area network, and eventually to XTEN -

Xerox's proposed long distance satellite and microwave communications network.

- INPUT predicts that within two years there will be a spectrum of laser driven printers from numerous vendors with the following range of characteristics:
  - Price - \$10,000 to \$100,000.
  - Speed - 10 pages/minute to 60 pages/minute.
  - Resolution - 200 dots/inch to 480 dots/inch.
  - Availability of multiple fonts and variable type sizes, as well as user defined character sets and forms generation capabilities.
  - Connection capability to various communication protocols.
- The high speed impact printer will not, however, quickly disappear. Two situations favoring the impact printer are likely to continue for several years.
  - For certain applications, use of multi-color, multi-part special purpose forms will be "required" until a "suitable" replacement can be demonstrated.
  - Applications where only a few lines are printed on a page, and the output volume is large (i.e., many thousands of pages are printed per job) can be done much more rapidly on impact printers with skip (over blank lines) speeds of 90 to 100 inches/second.
- A second trend becoming very visible in many organizations is the proliferation of word processing terminals - either connected to the central computer site or as part of standalone word processing systems. Much of the written material created within an organization is, or soon will be, captured electronically and stored on some type of computer readable media. The ramifications

of this trend are described in greater detail in the June 1979 INPUT report titled, "The Future of IBM Peripherals."

- Once words are captured electronically, the ability to print them in whatever form and format desired is a logical extension. The IBM 3800 provides only a crude capability. The Xerox 9700, with its relatively higher resolution, variable type size, and potential for graphics, is a step closer. IBM and others are exploring this area, and will provide output machines which incorporate and automate functions now residing in the in-plant press operation. Such functions may include:
  - Character sets with 512 or 1,024 characters loaded into the printing device under computer control.
  - A broad range of type faces (roman, italic, bold, and bold italic) and type styles which can be intermixed at the character level.
  - A broad range of type sizes, from small (e.g., 4 points) to large (e.g., 72 points).
  - A broad range of output quality from draft (perhaps 100 dots/inch resolution) to publication (500 dots/inch or higher resolution).
  - An ability to integrate line art and vector graphics - with image graphics and tone-out in perhaps latter product generations.
  - A broad range of paper handling capabilities from cut sheet to continuous forms in various sizes and paper weights.
  - Two sided printing.
  - A broad range of colored inks, although this capability (like complex graphics) is probably one or two product generations beyond the other functions listed here.



IV RESIDUAL VALUE FORECASTS FOR IBM 1403NI,  
3211, AND 3800 PRINTERS





#### IV RESIDUAL VALUE FORECASTS FOR IBM 1403NI, 3211, AND 3800 PRINTERS

- The three principal forces affecting residual values of IBM printers are:
  - The introduction of new products, either by IBM or by IBM's competitors.
  - Price changes to the existing product line.
  - The demand for, and availability of, printing systems either direct from the vendor or in the used market.
- The three IBM high speed printing systems in widespread use are the 1403 (announced in 1964), the 3211 (announced in 1969), and the 3800 (announced in 1975). This approximate five to six year cycle would suggest a new printing product from IBM is about due. IBM has in fact been actively soliciting user opinions on desired characteristics for a follow-on product to the 3800. Announcement of such a product is expected within the next 18 months.
- The price/performance ratios of new printer introductions from IBM have shown only slight improvement over prior generations. The pattern has been to provide improved function while keeping the price per line of output relatively constant.

- Competition in the high speed line printer market has been virtually non-existent until the recent emergence of Documation. The 1403 printer was a very well-designed product which potential plug compatible competitors found difficult to replicate. Greater competition exists in the page printer market, and this will result in a downward trend in cost per line of output as moderate cost, medium speed laser printers become widely available.
- Exhibit IV-1 presents the price history of the 1403NI, 3211, and 3800 printers and their respective control units (2821-2 and 3811). Since the early 1970s, there have been three modest (about 5% each) price increases for the 1403 printer. During this period, there were two major price reductions for the 3211 printer (10% in 1974 and 25% in 1978), which established a clear price/performance advantage for the 3211 over its 1403 predecessor. The large 3211 price reduction in 1978 caused a sharp downward drop in both 1403 and 3211 used market values (see Exhibits IV-2 and IV-3).
- There is little reason for IBM to reduce line printer costs or to attempt to improve upon the underlying technology. Thus, INPUT projects small price increases for the 1403 and 3211 in future years (to offset inflationary effects on manufacturing costs). The price of the 3800 compared to competitive products seems a bit high (see Exhibit III-1), and may be reduced a few months prior to the introduction of a replacement product line to encourage purchase of rented units. INPUT expects a new product line will be available within 18 months - early models of which may be unveiled with the H Series announcement expected later this year.
- The current availability of line printers either from vendors or from the used market is not a major problem. There has been a tendency for end users to hold on to line printers, even when the installation of a page printer has caused impact printing to decline to a small fraction of the former workload. Escalating maintenance costs for these typically fully amortized units will make this an expensive practice. INPUT expects to see a widening divergence between used market availability (increasing) and user demand (decreasing) which will put downward pressure on market values.

# EXHIBIT IV-1

## PRICE HISTORY OF IBM 1403NI, 3211, AND 3800 PRINTERS

PRINTER / CONTROL UNIT	YEAR				
	1964	1969	1971	1973-1975	1978-1979
1403NI	\$39,965	-	\$33,970	\$36,680, 38,140	\$40,040
2821-2 <sup>(1)</sup>	27,100	-	23,040	24,910, 25,900	27,190
3211	-	\$69,360	-	20,700 63,630	50,900, 53,440
3811 <sup>(2)</sup>	-	30,600	-	31,200, 28,080	22,460, 23,580
3800 <sup>(3)</sup>	-	-	-	\$310,000	\$325,500 341,750

(1) THE 2821-2 IS THE IBM CONTROL UNIT NECESSARY FOR ATTACHING THE 1403N1 PRINTER TO A HOST COMPUTER. OTHER CONTROL UNITS IN THE 2821 SERIES ARE AVAILABLE WHICH PERMIT ATTACHING ADDITIONAL 1403 PRINTERS AND ALSO THE IBM 2540 CARD READER/PUNCH

(2) THE 3811 IS THE IBM CONTROL UNIT FOR THE 3211 PRINTER

(3) THE 3800 PRINTER HAS A SELF-CONTAINED CONTROL UNIT

## EXHIBIT IV-2

### RESIDUAL VALUE FORECAST FOR IBM 1403N1 PRINTER

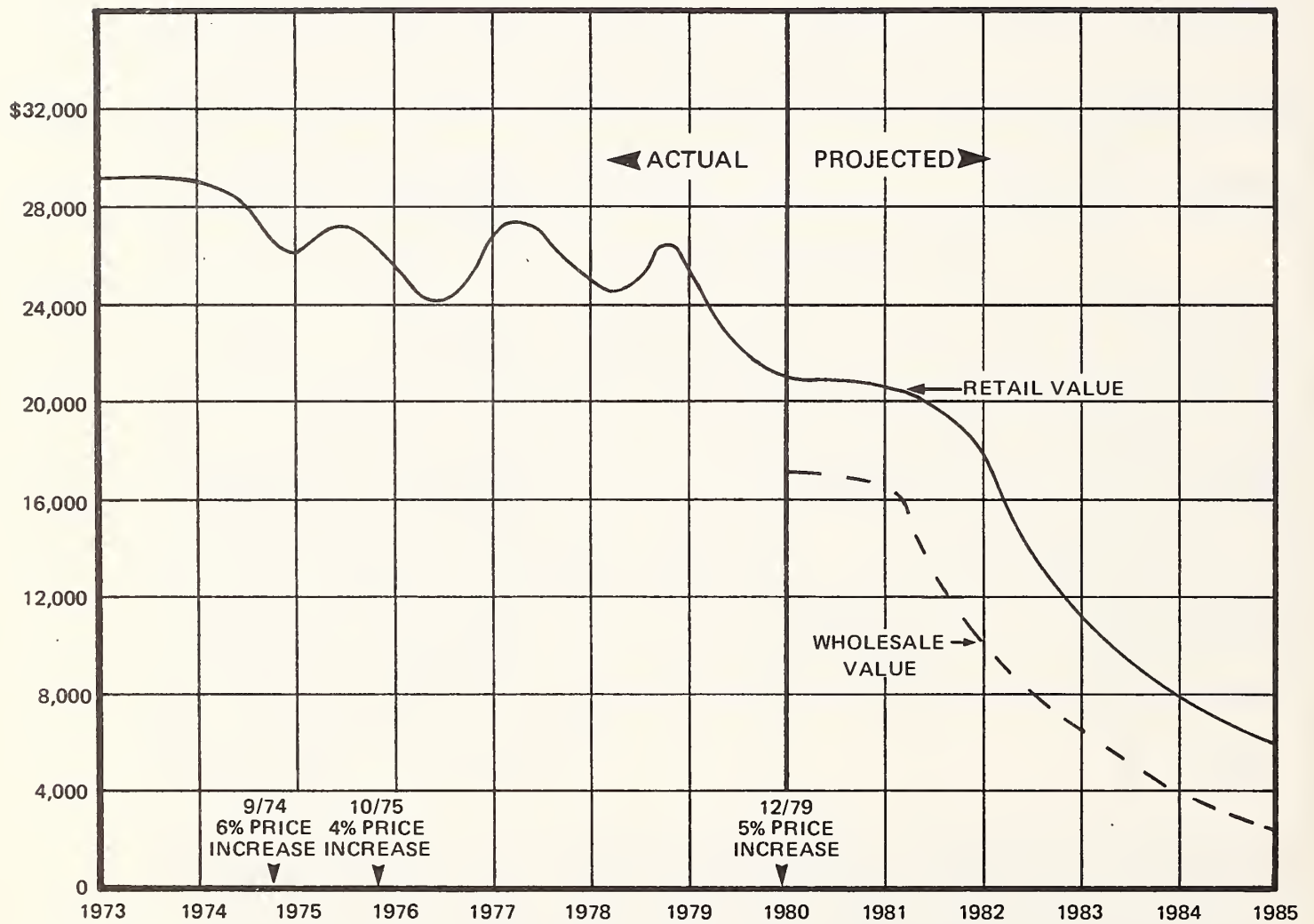
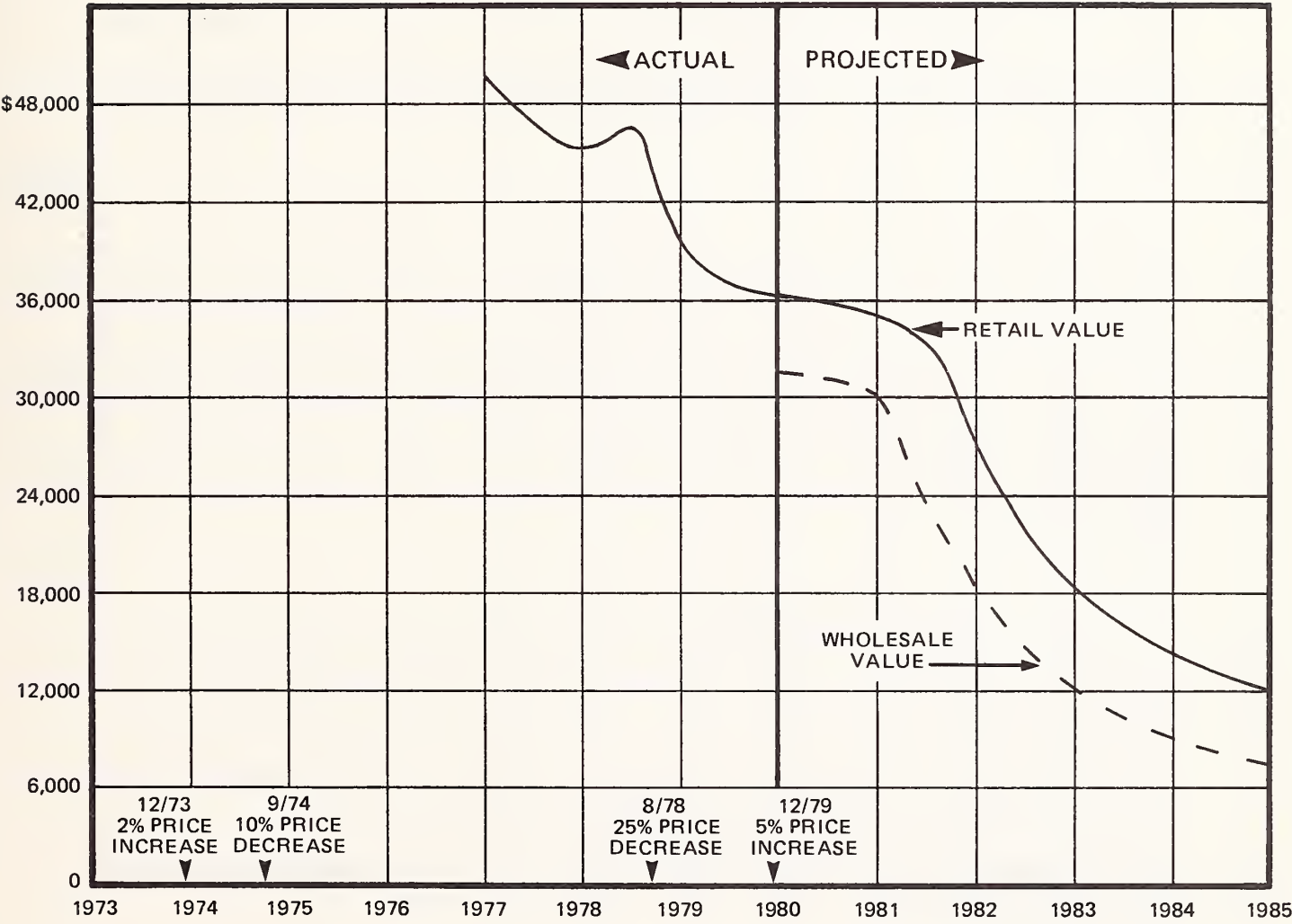


EXHIBIT IV-3

RESIDUAL VALUE FORECAST  
FOR IBM 3211 PRINTER

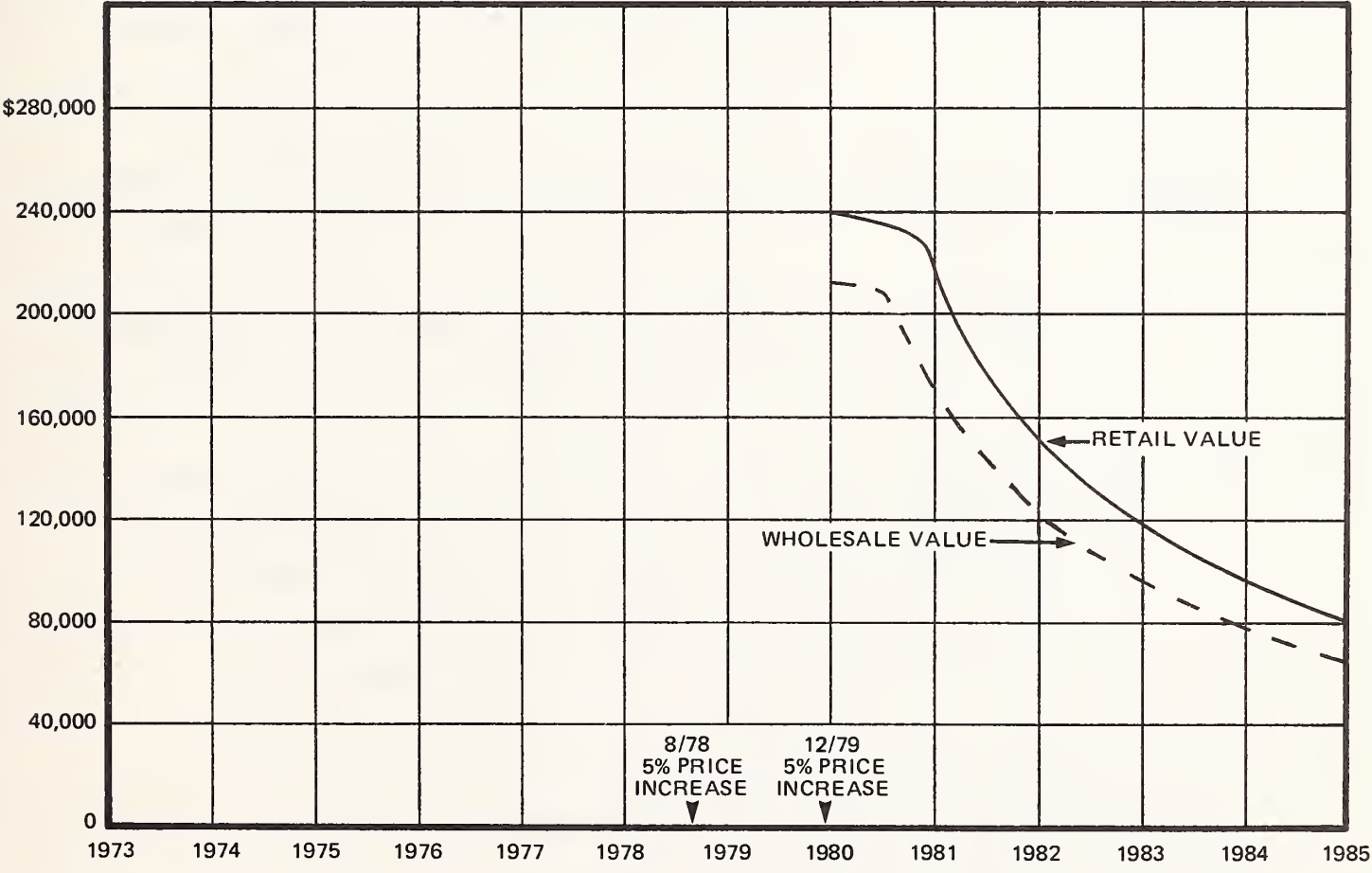




- There has been no used market trading activity in 3800 printers. A recent survey by INPUT of large computer sites (December 1979 report titled "Mass Storage and Other Peripheral Devices: Cost, Performance, and Future Directions") indicated 25% had laser page printers installed and 37% planned to install in the near future. Many of the remaining 38% indicated they would wait for slower and less expensive page printers. Thus, there appears to be significant demand both near and long term for page printing systems.
- Two lines representing projected used market values for 1403, 3211, and 3800 printers are shown in Exhibits IV-2, IV-3, and IV-4. The solid line represents expected retail value; i.e., the equipment broker's resale price for the item. The broken line represents wholesale value; i.e., the broker's cost to purchase the item.
- INPUT expects market values for the 1403, 3211, and 3800 printers to decline by roughly a factor of 3 by 1985. 1403 and 3211 values are expected to remain close to current values for the next 18 months, after which slower speed but less costly page printers will begin displacing the aging 1403 and 3211 units in significant quantity. This expected influx into a used market that will be experiencing declining demand will cause 1403 and 3211 values to drop rather quickly.
- The present value of a used 3800 printer is estimated at 75% of current list price, or about \$240,000. The wholesale price is estimated at 65% of list, or \$211,000. INPUT projects a price decrease in list price prior to a new product line introduction, the impact of which will be seen in 12-18 months. Page printer products with greatly improved functionality and better price/performance, appearing in the early 1980s, will cause the marked decline in value shown in Exhibit IV-4.
- Residual value forecasts for page printing systems other than IBM are very difficult to predict. The market for non-IBM products tends to be much more specialized. Computer equipment brokers are generally reluctant to handle equipment which requires "selling" rather than "placing" - for generally there

EXHIBIT IV-4

RESIDUAL VALUE FORECAST  
FOR IBM 3800 PRINTER





exists a ready market for current generation IBM equipment (provided it has been under continuous IBM maintenance) but this may not be true for a like product from a plug compatible vendor.

- The used market is always sensitive to supply versus demand relationships. When a given product appears infrequently in this market, as we expect will be the case with high speed page printers, anticipating demand (which will heavily influence the selling price) is very difficult. It is thus prudent in such a situation not to require a sizable future residual value in order to justify a purchase rather than lease decision. In some cases, to acquire the business or encourage purchase, vendors have guaranteed future "trade-in" value toward new generation products - a tactic INPUT subscribers may wish to explore with non-IBM page printer vendors.
- An exception to this questionable future demand prediction may be the Xerox 9700 printer. There are two factors favoring future demand for this product:
  - First, there is growing interest about the product within the printing industry - which may lead to establishment of a secondary market.
  - Second, the higher resolution, variable type size, two sided printing option, and other attractive features vis-a-vis other alternatives have led to interfaces to word processors and various computers such as Digital Equipment's VAX 11/780. Thus, the 9700 will soon have a large variety of hosts and operating systems to which it can attach.
- Future trading volume in Honeywell and National Advanced Systems is expected to be very infrequent. Value will be extremely difficult to establish and will be strongly influenced by the number of potential buyers willing to bid.

- The Xerox 9700, for reasons given above, will appeal to a broader base of potential users and may outperform the 3800 in the used market. In fact, the strongest competition to a used 9700 may be the smaller, slower, cheaper, versions of the 9700 expected within the next year or so.



**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer and Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Field Service Planning Information Program - Provides senior field service managers with basic information and data to support their planning and operational decisions.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$100,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1980 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2471 East Bayshore Road  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
Airwork House (4th Floor)  
35 Piccadilly  
London, W.1.  
England  
01-734-2156  
Telex 269776

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090



U  
RV7

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

U-RV7  
RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

JUNE 1980

## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts - Two reports providing detailed five-year forecasts of residual values of major computer equipment.
- Vendor Watch Reports - Six reports which analyze the probable moves of major computer/communications vendors in operating systems, DB/DC software, mainframes, Value Added Networks, mass storage and other areas.
- EDP and Communications Planning Report - Contains analyses and composite forecasts of both short and long-term plans of computer/communications users. Includes operating ratio data.
- Impact/Technology Reports - At least three in-depth analyses of the impact on users of projected technological, managerial, and personnel developments over the next five years.
- Conferences - National conference for all clients held at a convenient location in November. Local and regional conferences held according to client interest.
- Consulting Support - Individual consultation with research staff on an as-needed basis through telephone inquiries and visits.
- Presentations - INPUT staff makes general or specific presentations to client management or staff at client's location.

**RESEARCH METHOD:** INPUT carries out extensive research in computers, communications and associated fields:

- Research topics are selected by INPUT based on discussions with client representatives.
- Research for this program includes professional interviews with users, vendors, universities, industry associations, and other analysts.
- Conclusions derived from the research are founded on the judgement of INPUT's staff.
- Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ 07662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Road  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600



U-RV7  
RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
PLUG COMPATIBLE MAINFRAMES

JUNE 1980



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES

## ABSTRACT

This report presents the periodic update of the residual value forecast for large IBM and plug compatible mainframes. In addition, the accuracy of INPUT forecasts since publication of the first large processor residual value predictions in June 1977 is reviewed. Special attention is given to the announcement of the IBM 3033N and the formation of National Advanced Systems to market and support the former Intel computer lines which are manufactured by Hitachi and National Semiconductor.

U-RV7  
June 1980

INPUT



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES JUNE 1980

## TABLE OF CONTENTS

		<u>Page</u>
I	INTRODUCTION .....	1
II	INPUT RESIDUAL VALUE PROJECTIONS VERSUS ACTUAL USED MARKET TRADING - 1977 TO PRESENT .....	3
III	REVIEW OF VENDOR ANNOUNCEMENTS (NOVEMBER 1979 - MAY 1980) .....	7
	A. IBM Announcements .....	7
	1. November 1979 .....	7
	2. January 1980 .....	8
	3. February 1980 .....	9
	B. Amdahl Announcements .....	9
	1. October 1979 .....	9
	2. November 1979 .....	10
	3. January 1980 .....	10
	4. March 1980 .....	10
	C. National Advanced Systems Announcements .....	11
	1. November 1979 .....	11
	2. January 1980 .....	12
IV	EXPECTED FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES .....	13
V	PROJECTED RESIDUAL VALUES FOR LARGE IBM AND PLUG COMPATIBLE PROCESSORS .....	17



RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND PLUG COMPATIBLE MAINFRAMES  
JUNE 1980

LIST OF EXHIBITS

		<u>Page</u>
II	-1 INPUT June 1977 Residual Value Projections For IBM 370/168 Processor Versus Actual	4
V	-1 Actual And Projected Wholesale Values For IBM 370/158-3 Processor	18
	-2 Actual And Projected Wholesale Values For IBM 370/168-3 Processor	19
	-3 Projected Wholesale Values For The IBM 3031 Processor	22
	-4 Projected Wholesale Values For The IBM 3032 Processor	23
	-5 Projected Wholesale Values For The IBM 3033N Processor	24
	-6 Projected Wholesale Values For The IBM 3033 Processor	25
	-7 Projected Wholesale Values For The Amdahl V/5 And V/6 Processors	27
	-8 Projected Wholesale Values For The Amdahl V/7 And V/8 Processors	28
	-9 Projected Wholesale Values For the NAS 5000 Processor	30
	-10 Projected Wholesale Values For The NAS 7000 Processor	31





## I INTRODUCTION



## I INTRODUCTION

- This Residual Value Forecast is produced as part of the Planning Service for Computer and Communications Users. Data contained in this series of reports is updated periodically. Key issues, such as the future of IBM hardware and software and major product announcements, are the subjects of various other INPUT reports including the "Vendor Watch" series, produced as another part of the User Planning Service.
- In October 1979, INPUT published the fourth report in its continuing series on residual value of large IBM and IBM plug compatible CPUs. This report reviews significant events since October and updates the earlier residual value forecasts based on an analysis of recent developments.
- Forecasted residual values are provided for the IBM System/370 Model 158-3, System/370 Model 168-3, 3031, 3032, 3033N, and 3033 CPUs, the Amdahl 470 V/5, V/6, V/7, and V/8 CPUs, and the National Advanced Systems (NAS) AS/5000 and AS/7000 CPUs.
- Chapter II of this report reviews the accuracy of INPUT forecasts since publication of the first large processor residual value predictions in June 1977. Residual value forecasting is partly a science and partly an art. Science provides tools for analyzing various parameters which affect residual values. It can also provide clues to expected future events (e.g., new product announcements, pricing changes, etc.). There is, however, a need to assess the impact such events will have in the marketplace, and this requires careful evaluation of past forecasts.

- Chapter III reviews vendor announcements (with commentary on their significance) since the previous report published last October. It has been a time of moderate activity as the industry awaits the appearance of IBM's next product generation. There is a new player now that Intel has sold its computer product line to National Semiconductor. The new player has been named National Advanced Systems (NAS). Amdahl computers may also acquire a new name once the merger with Storage Technology is completed.
- Expected future developments affecting residual values are discussed in Chapter IV. This section is kept relatively brief since INPUT has described its projections of future technical directions for IBM and others in considerable depth in the "Vendor Watch" reports.
- Residual value projections for each of the CPUs covered by this report are given in Chapter V. The used computer industry by convention always lists used equipment as a percentage of the manufacturer's current list price. The projections shown in graphical form in Chapter V follow this convention.
  - Readers are cautioned to consider price changes which have occurred when analyzing their own unique situations.
  - For instance, a two megabyte 370/158 selling at 30% of the current \$1.46 million list price would bring \$0.44 million - a 21% return on the \$2.1 million price in effect before 4/1/77.
  - During this report period (10/79 - 6/80), IBM reduced prices of the 3031 and 3032 processors by 20% and the 3033 processor by 15%.
- Variables which affect residual values are discussed in some depth in the Appendices. An analysis of the complex interrelationships between these variables produces the residual value forecasts provided in Chapter V.
- INPUT also plans to continue a price/performance analysis and residual value forecast for selected peripheral product lines as part of this series. The next report for peripheral residual values will be published in September 1980 and will be an update of an earlier INPUT residual value study of disk storage equipment.

II INPUT RESIDUAL VALUE PROJECTIONS VERSUS  
ACTUAL USED MARKET TRADING -  
1977 TO PRESENT

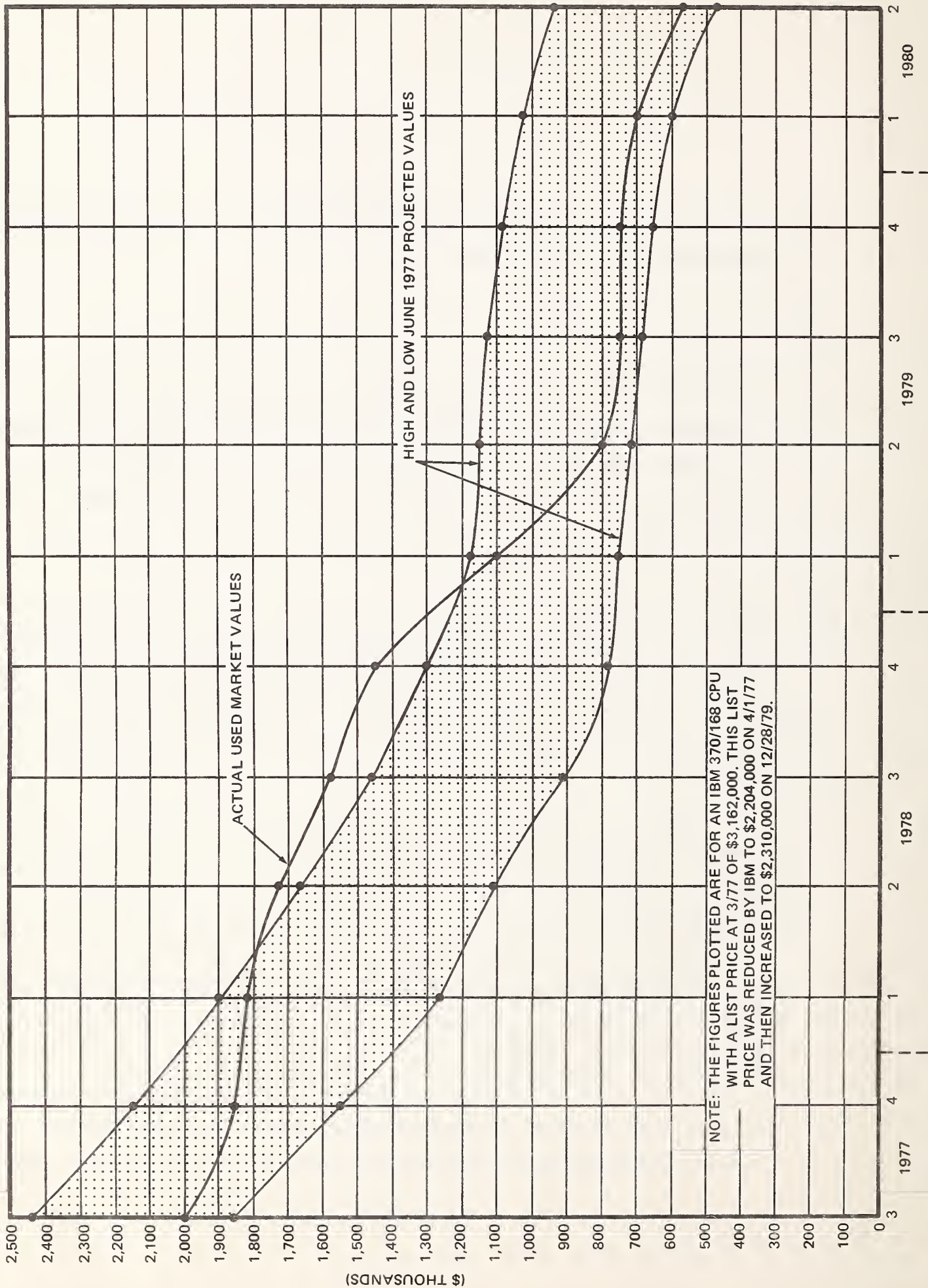




## II INPUT RESIDUAL VALUE PROJECTIONS VERSUS ACTUAL USED MARKET TRADING - 1977 TO PRESENT

- INPUT first provided residual value projections of large IBM and plug compatible computers in the report "New Hardware Economics" published in June 1977. Updates to those initial projections have been published semi-annually as part of The Planning Service for Computer and Communications Users.
- Exhibit II-1 graphs the projections made in 1977 for a 370/168 processor and shows the actual used market value for this processor since that time. Projections and actual values for the 370/158 CPU would portray a similar picture. Updates published since June 1977 projections have incorporated changing market factors and have bracketed actual values more accurately.
- The June 1977 projections also included the 3033 CPU (the 3031 and 3032 had not yet been announced) and the Amdahl 470 V/6 CPU. The values projected for both have proven - to date - to be quite good; i.e., projections for the IBM 3033 and Amdahl V6 in this report differ very little from the June 1977 predictions. For instance, the forecasts made at June 1977 projected the 3033 would hold its value in the low 80% of list price until early 1980, then decline to about 50% of list by mid-1981 - a scenario which portrays relatively closely what has actually happened.
- In the "New Hardware Economics" report, INPUT expressed the idea that a new era was beginning and that previous trends in both new and used values for

INPUT JUNE 1977 RESIDUAL VALUE PROJECTIONS FOR IBM 370/168 PROCESSOR VERSUS ACTUAL



large computers was going to change significantly. The residual value predictions assumed this would be recognized immediately in the marketplace and that values of existing processors would decline rapidly until a point of stabilization was reached. Stabilization was expected to occur for 158 and 168 CPUs when price/performance approximated 303X values (about 12 to 18 months from June 1977). Values would then slowly decline until sharply impacted by a new product announcement by IBM in the 1980-1981 timeframe.

- As shown in Exhibit II-1, this stabilization did occur (slightly after the timeframe predicted); however, the manner by which it happened was not as forecasted. The 370/168 retained its value at higher than projected values until the fourth quarter of 1978. Two reasons for this were:
  - The delivery schedules for the 303X machines were much longer than expected. Many users found that 303X deliveries were too far in the future to meet pressing capacity upgrade needs - and thus demand for 158 and 168 CPUs remained strong.
  - The Amdahl and early 303X machine installations tended to add to, rather than to replace, 158 and 168 processors. The supply of used 158 and 168 processors entering the used market was lower than expected. In some cases, people who had purchased their 158 or 168 prior to the large April 1, 1977, price cut and were using outdated depreciation schedules now faced a large loss on sale and, instead of exposing this problem, found a convenient home for the machine within the organization.
- In the first update to the June 1977 residual projections (published in April 1978), INPUT raised its projected values by about 10 percentage points on the assumption that suppressed demand for CPU capacity would continue to prop up 158 and 168 values through the early 1980s. This assumption was quickly invalidated, and the October 1978 update report readjusted projections downward (close to the original June 1977 forecast).



- Subsequent updates (March 1979 and October 1979) have lowered slightly the June 1977 projections and have accurately reflected actual 158 and 168 trading values over the past several months.
- The last residual value update report in this series (October 1979) combined 3032 and 3033 values on a single graph on the assumption that used values for the two machines would remain relatively close. This has not happened. The "expected" value curve has reflected actual 3033 activity while the 3032 has diverged towards the "low" values. In the October 1979 report, INPUT said that this would happen if the projected price reductions for the 303X machines were not uniform; e.g., a larger price reduction for the 3032 than for the 3033. This, of course, is what did happen when IBM reduced 303X prices in November of 1979.
- Overall, INPUT's record compares more than favorably with projections made by others - at least those which INPUT is aware of. The changes and new patterns INPUT predicted in early 1977 have, for the most part, come to be.
- It should be noted, however, that residual value projections are based on what should happen given certain key events. The used computer market, like the stock market, doesn't always behave "as it should," and, thus, accuracy in predicting new product announcements or other significant events does not guarantee accurate residual value forecasting. Experience is a great teacher, and the experience INPUT has gained over the past three years should lead to more accurate projections in future reports.

III REVIEW OF VENDOR ANNOUNCEMENTS  
(NOVEMBER 1979 - MAY 1980)



### III REVIEW OF VENDOR ANNOUNCEMENTS (NOVEMBER 1979 - MAY 1980)

#### A. IBM ANNOUNCEMENTS

##### I. NOVEMBER 1979

- On November 1, 1979, IBM reduced prices of the 3031 and 3032 processors by 20%, and the 3033 by 15%. Main memory price was cut 33% - from \$75,000 per megabyte to \$50,000 per megabyte. The primary intent of this action was to stimulate the conversion from lease to purchase for already installed 303X systems, and to make purchase relatively more attractive for new installations. IBM is concerned about the high percentage of rented and leased machines in end user sites as it approaches "H" series introduction.
- Prices for minimum configuration systems became:
  - 3031, 2 megabytes of memory, 6 channels = \$800,000.
  - 3032, 2 megabytes of memory, 6 channels - \$1,520,000.
  - 3033N, 4 megabytes of memory, 6 channels = \$1,800,000.
  - 3033, 4 megabytes of memory, 12 channels - \$2,810,000.
- The reduction in memory purchase price made the rental cost per megabyte (about \$3,300/month) very high compared to the \$50,000 purchase cost; i.e.,



about 15 months' equivalent rent ignoring maintenance, warranty, and interest cost factors. IBM does not allow features such as incremental memory to be purchased if installation is to be made on a rented/leased machine; however, it is possible to install purchased third-party memory for those seeking cost savings.

- The November announcement included a new 3033 processor model - the 3033N. IBM reduced the performance of the base 3033 machine by about one million instructions per second (MIPS) by reducing cache memory size from 64K to 16K, using four-way rather than eight-way memory interleaving, and making microcode changes. These actions produced a machine comfortably positioned between the 3032 and 3033, which can be upgraded in the field back to a full 3033. It also provides a much more cost competitive (on a \$/MIPS basis) for users upgrading from the 3031. Amdahl has been successful in touting the virtues of upgrading in place, and IBM needed to counter this marketing tactic. IBM can now point to the 3033N to 3033 to 3033AP to 3033MP as such a path. The initial 3033N came in four and eight megabyte versions. Twelve and 16 megabyte models were announced in April 1980.

## 2. JANUARY 1980

- IBM surprised some industry watchers by increasing prices in January. There was a non-characteristic inconsistency with processor price changes. For the 303X series, only lease and rental prices were changed (purchase and maintenance costs remained the same). For the 370 series, both lease/rent and purchase prices went up, but maintenance remained the same. For the 43XX series, everything went up. Inflationary pressures were blamed for the increased prices. One effect was to increase the relative attractiveness of 303X purchase versus lease. It should also help 1980 earnings. (Security analysts project about 20¢ per share improvement as a result of the price hike.)

### 3. FEBRUARY 1980

- IBM operating results for 1979 were released. The trend towards leasing impacted earnings growth rate, which was up only slightly over the previous year. The gross margin on sales declined from 30% to 26%, a marked drop which was a likely factor in the decision to increase prices. Since 1975, the percentage of revenues represented by data processing equipment sales/rentals has dropped from 72% to 66%, while the maintenance and software revenue contribution has increased from 10% to 15%. This trend will continue, with software becoming a much more significant revenue source in the future. Indeed, in February IBM announced that all future enhancements to VM will be available only as priced program products.

## B. AMDAHL ANNOUNCEMENTS

### I. OCTOBER 1979

- Amdahl's vulnerability to the current trend towards leasing rather than purchasing was highlighted by third quarter earnings (\$1.8 million versus 1978's \$12.9 million) in spite of higher shipment levels. And things are not improving, as both fourth quarter 1979 and first quarter 1980 earnings were \$0.5 million (versus \$14.7 million and \$13.5 million in fourth quarter 1978 and first quarter 1979). Diversification into other areas is one way to insulate against this problem - and Amdahl moved aggressively in this direction during the current reporting period.
- Also in October, Thomas Simpson joined Amdahl as a "technical director to the corporation." As the person responsible for IBM's HASP and JES2 product developments, Simpson considerably strengthens Amdahl's expertise in large computer operating system software.

## 2. NOVEMBER 1979

- Amdahl instantly reacted to IBM's November 1 price reductions with equivalent price declines. It also introduced a new processor to counter IBM's 3033N. The reduction on processors ranged from 16% to 28%. The 28% price cut was for the 470/7A. This price was "readjusted" upward by \$100,000 when Amdahl increased lease prices in May 1980 - suggesting the large November reduction may have been a "goof" which slipped by in the rush to get the new figures announced. Memory prices were brought in line with IBM; i.e., \$50,000 per megabyte.
- The new processor was labelled the 470/7B, with equivalent power to the 3033N but at about 75% of the price. A four-megabyte, eight-channel machine sells for \$1,450,000. An accelerator feature is available (identical concept and pricing to the accelerator announced with the 470/7A), which increases power by 30%, or to the 7A level. The 7B is field upgradable to a V7A, V7, or V8.

## 3. JANUARY 1980

- Amdahl followed IBM's lead and increased lease prices by 6.5% to 8.3%. Purchase prices were held constant. The price increase helped offset increasing interest costs on borrowings to finance the growing lease base, but apparently not by enough. In May 1980, Amdahl again increased lease prices (by 7-14%) reflecting the very steep increase in the prime lending rate. Maintenance prices were also raised in May to 5-7%.

## 4. MARCH 1980

- Two major steps towards diversification were taken in March. First, an agreement was executed to acquire Tran Telecommunications Corporation, a small company (\$22 million in sales) involved in the design and manufacture of digital communications networks. Shortly thereafter, a letter of intent was signed to merge with Storage Technology Corporation (STC). These two

actions not only provide a much broader product base but, more importantly, they are steps toward a "total systems company." Amdahl would like to be in a position to install complete, integrated systems on the end user site. This not only puts them in a stronger competitive position, but provides the obvious benefit of receiving revenue from all the component pieces (i.e., disks, tape drives, communication equipment, etc.).

## **C. NATIONAL ADVANCED SYSTEMS ANNOUNCEMENTS**

- National Advanced Systems (NAS) is the subsidiary formed in October 1979 by National Semiconductor to market the product line acquired from ITEL. This product line includes computer processors manufactured by National Semiconductor (the AS/3000 and AS/5000 products) and Hitachi (the AS/7000 series). Prior to this transfer, CPUs from National Semiconductor were marketed by ITEL as the AS4 and AS5 series, while Hitachi-manufactured CPUs were marketed as the AS6 and AS7 product line.

### **I. NOVEMBER 1979**

- In response to the IBM 303X price reductions, NAS set a price of \$600,000 for the 7031 CPU. ITEL had listed this machine at \$950,000; however, the actual selling price was frequently at a much lower, "negotiated" figure. NAS also lowered the price of memory to \$40,000 per megabyte. However, in all subsequent product "re-announcements," including the renaming of the 7031 as the AS/5000, memory is listed at \$50,000 per megabyte.
- NAS also indicated a leasing program was available, but declined to provide actual prices
- In early February, NAS again indicated it "will offer" leasing programs, but did not provide prices. It expected prices would be at least 30% less than IBM's comparable lease programs. In mid-March, a 12-month lease program for the



AS/5000 was announced. This seemed to suggest that the large inventory of AS/5000 CPUs (the previously labeled 7031), estimated at about 50 machines in late 1979, had not yet been disposed of.

- When comparing lease pricing, INPUT advises a careful examination of what is included in the lease price so that an "apples versus apples" comparison is truly made. Differing treatments of the investment tax credit (ITC) serve as an example. Amdahl's quoted lease rates assume that two-thirds of the ITC is passed through to the customer. IBM passes all of the ITC to the customer. NAS has not yet announced its policy.

2. JANUARY 1980

- NAS established its product line in January, "announcing" both the Hitachi-made AS/7000 series and National Semiconductor-built AS/3000 series. On-site upgradability is available within a given series, but not between the product groups.
- The product line is:

<u>Model</u>	<u>Purchase Price (Minimum Configuration)</u>	<u>Min/Max Memory</u>	<u>Min/Max Channels</u>	<u>Approximate Performance</u>
AS/3000N	\$ 325,000	2/4 Megabytes	5/5	0.7 x 3031
AS/3000	\$ 425,000	2/8 Megabytes	5/5	0.9 x 3031
AS/5000	\$ 600,000	2/8 Megabytes	6/6	1.15 x 3031
AS/7000N	\$1,100,000	2/8 Megabytes	6/8	0.8 x 3032
AS/7000	\$1,525,000	4/16 Megabytes	8/16	1.2 x 3032

#### IV EXPECTED FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES





#### IV EXPECTED FUTURE DEVELOPMENTS AFFECTING RESIDUAL VALUES

- Available evidence supports the contention that the rapid rate of change seen in the last decade in available technology, providing increasing capability but with increasing complexity, will continue almost indefinitely.
- The appetite for computer processing power seems virtually insatiable. New technologies (e.g., Josephson junctions) will be perfected and exploited when current ones reach their limits.
- The present silicon-based semiconductor technology is projected to provide 20-30% improvements per year in logic circuit and memory density for the remainder of this decade. Ion milling, laser annealing, design automation systems, and other evolving tools will permit constructing even denser chips. New thermal management techniques to solve heat dissipation problems and new approaches to chip packaging will permit building faster, more powerful computers that require less power and maintenance and cost less money for given performance levels.
- The increasing demand for greater processing capabilities and a growing reliance on the computer to support vital functions is leading towards multiple-processor systems. Present software limitations cause severe efficiency loss as the number of processors increases beyond two. Examples of current problem areas are:

- Synchronization of independently clocked computers and peripheral subsystems.
  - Interlocks to protect against simultaneous data updating.
  - Management of system-wide tables and multiple resource managers.
- New applications in data management, office automation, and communications - important in maintaining (i.e., absorbing) computer capacity - will require virtually non-stop operation. Improvements in security and information storage hierarchies will also be needed.
  - Information Resource Management (IRM) has replaced Management Information Systems (MIS) and is the consultant buzz word for the 1980s. The concept is that information is as much an asset to the organization as plant or inventories and should be managed accordingly. An organization-wide, integrated information management system will require significant computing capacity and will demand 24-hour, seven-days-a-week availability.
  - A second area receiving significant attention is office automation. Controversy exists as to whether such automation will be provided from large central systems or small distributed systems - and the answer is that it will probably be some of both, depending on where files are stored and processed and who must access what information at what location. To be successful, office automation systems must provide very convenient access for even the most casual user, and must provide both reliable and available (again at essentially any time) file systems.
  - Digital communication (including electronic mail and conferencing systems) is what binds the components together. Network management will require high-capacity, non-stop computing engines to manage addressing and routing, directories, switching, etc.

- These new applications will require large processors with capabilities not present in the 370 and 303X systems. Once the new applications are available (and the "H" series should see a start in this very high reliability direction), the 370s and 303Xs will decline drastically in value.
- IBM does not make great leaps forward. The investment in software presently running on IBM computers is estimated at \$300 billion. People will not acquire new machines on which their software investment is inoperable. This is a definite restriction in introducing new CPU product generation.
- INPUT thus believes (and has projected accordingly since 1978) that IBM will "back into" multiple processor systems by extending the Attached Processor (AP) concept from two to four, and as a next phase, to permit such clusters to be interconnected using Multiple Processor (MP) coupling. The software problems involved in this, as mentioned earlier, are non-trivial. They are, however, being vigorously worked on.
- New disk, tape, and communication controller products are expected as part of the "H" series announcement. Native-mode MVS is not expected to be ready, and thus MVS under VM will be the likely operating system.



V PROJECTED RESIDUAL VALUES FOR LARGE  
IBM AND PLUG COMPATIBLE PROCESSORS



## V PROJECTED RESIDUAL VALUES FOR LARGE IBM AND PLUG COMPATIBLE PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the plug compatible mainframe manufacturers.
  - Analysis of technology development and how it affects the changing role of the large CPU in evolving communications/data base networks.
  - Analysis of other variables affecting residual values, as described in the Appendices.
- The residual value curves in Exhibits IV-1 and IV-2 show actual list prices for IBM System/370 Model 158-3 and System/370 Model 168-3 processors through April 1979, and projected values to January 1985.
- The projections for IBM 158-3 and 168-3 processor residual values are unchanged from the prior INPUT residual forecast (October 1979). Current values are slightly below the October 1979 forecast, due primarily to an oversupply versus demand imbalance; however, assumptions concerning fundamental forces and projected actions remain unchanged.



EXHIBIT V-1  
ACTUAL AND PROJECTED WHOLESALE VALUES  
FOR IBM 370/158-3 PROCESSOR

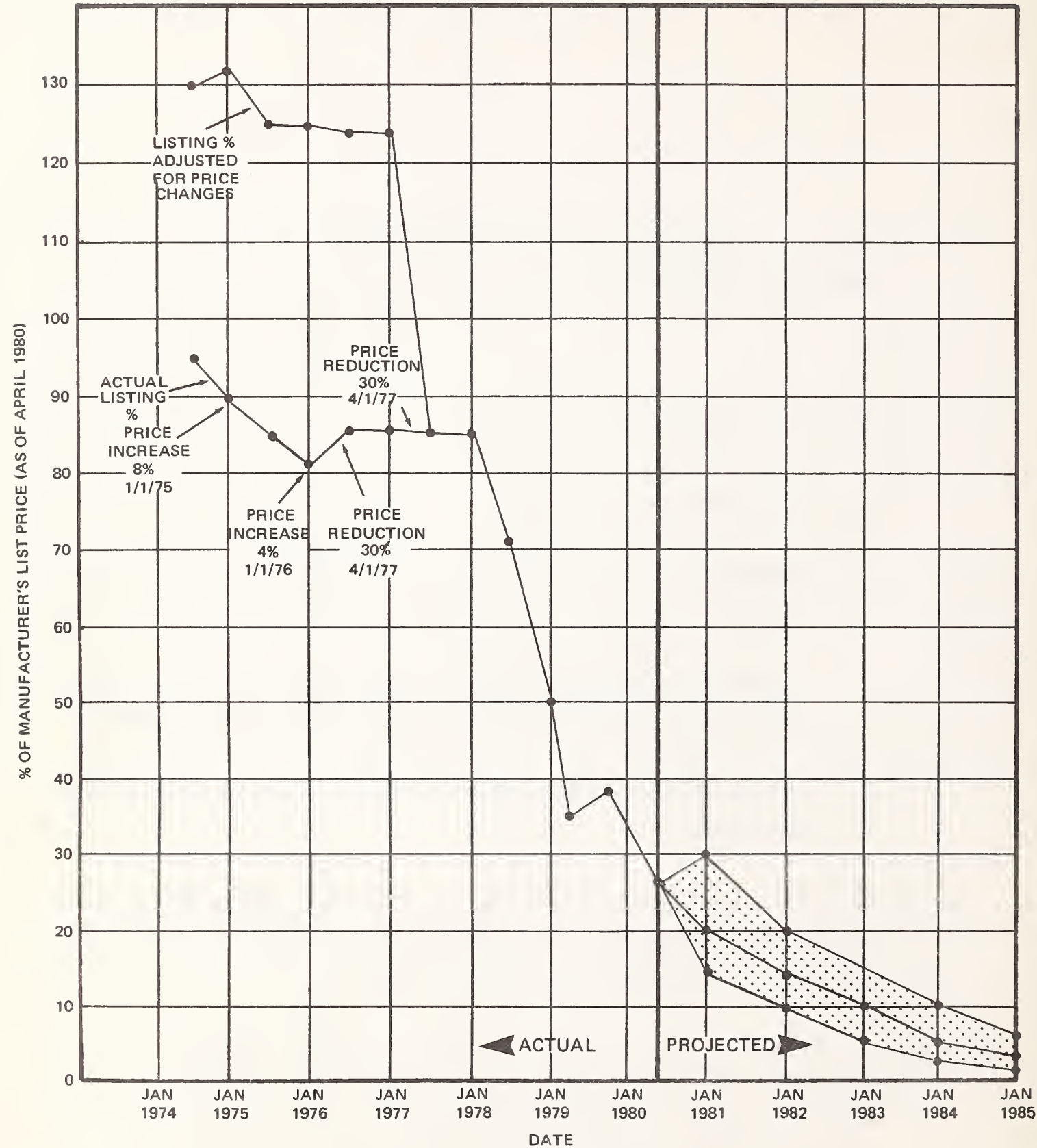
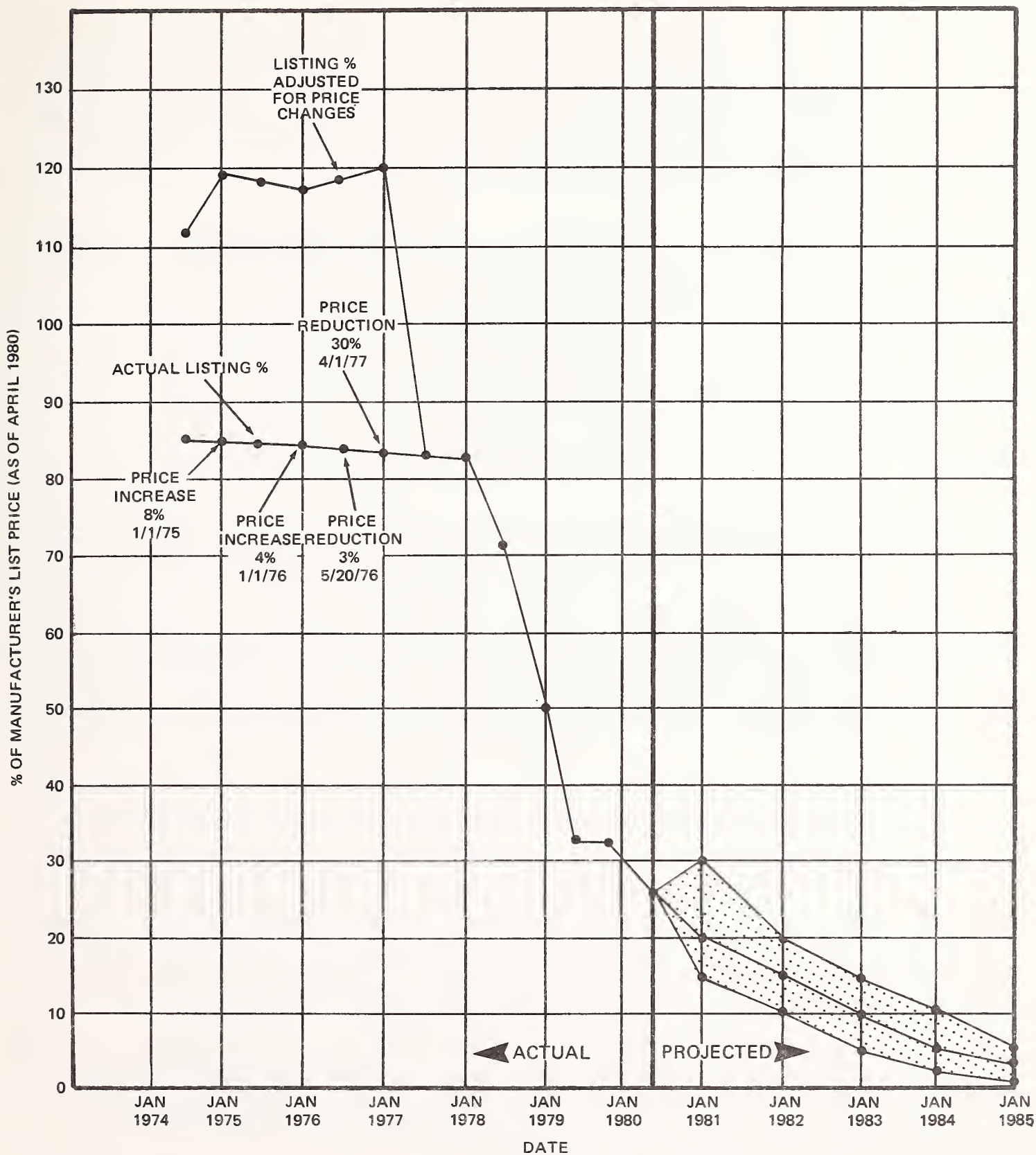


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	30%	20%	15%	10%	5%
EXPECTED	20%	15%	10%	5%	3%
LOW	15%	10%	5%	3%	1%

# **EXHIBIT V-2** **ACTUAL AND PROJECTED WHOLESALE VALUES** **FOR IBM 370/168-3 PROCESSOR**



**TABLE OF VALUES**

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	30%	20%	15%	10%	5%
EXPECTED	20%	15%	10%	5%	3%
LOW	15%	10%	5%	3%	1%

- Currently, it is a buyer's market, with many 158s and 168s available. Compared to new 303X prices, they provide very attractive values. A poll of used market dealers indicated the following number of CPUs are available now or are expected to be available (for lease and/or purchase) in the near future:

	<u>CPU MODEL</u>	<u>NUMBER AVAILABLE</u>
IBM	370/158	40-50
	370/168	10-15
	3031	5-7*
	3032	4-6*
	3033	2-3*
Amdahl	470/V6	4-5

\* Almost all are lease rather than purchase situations.

- There is a growing price differential between model 1s and model 3s (for both 158 and 168 CPUs). This appears to be caused by a larger available surplus of model 1s, perhaps caused by the inability to run the MVS Systems Extension Software on the model 1. There is a processor upgrade RPQ available which, when installed, does permit the "upgraded" model 1 to run MVS/SE; however, it costs over \$170,000 and IBM is quoting a lead time of several months for delivery.
- Although dollar cost per million instructions per second (or \$/MIPS) is only a crude measure of relative price/performance (partially because the MIPS delivered for any given CPU is variable with the type of work being done), it does provide a convenient yardstick to measure relative values. For instance, used 158 and 168 CPUs are presently at \$300,000-350,000/MIPS, or approximately the same \$/MIPS range as the IBM 43XX series.
- The list price of the 303X series is in the \$700,000-800,000/MIPS range, or over twice current used 158 and 168 values (with a comparable number of channels and equivalent main memory).
- Thus, current 158 and 168 values are on par with both 43XX levels and expected "H" series pricing, and should remain rather stable - but with short-term swings related to relative supply versus demand situations. INPUT thus



predicts a relatively gradual but persistent decline in I58 and I68 values for the balance of their viability (i.e., to the 1984/85 timeframe). By 1985, maintenance and energy consumption costs will make 370 series CPUs (which include the 303X processors) noncompetitive with newer products.

- It should be noted that economic factors (e.g., gyrating interest rates and recession fears) have had a much greater impact on residual values than has been the case in prior reporting periods. Acquisition decisions in some cases have been complicated (and thus postponed) by economic uncertainty. Should interest rates fall significantly, and recession effects cause people to seek lower cost alternatives, the I58/I68 oversupply imbalance may disappear - with favorable effect on their market values.
- Projected IBM 303I, 3032, 3033N, and 3033 values are shown in Exhibits V-3, V-4, V-5, and V-6 respectively.
- INPUT predicts IBM's short-term market strategy for the 303X series is to introduce a new processor model and to readjust 303I, 3032, and 3033 pricing to reflect more closely the 3033N value of \$500,000-550,000/MIPS.
- A new processor model would signal the extension of the 303X product life - a key consideration in evaluating whether to purchase a presently leased or rented machine. A price reduction, even if relatively modest, would trigger a lease-versus-purchase review by most 303X lessees.
- IBM is in a position to announce an eight MIPS uniprocessor, but may instead choose simply to market an Attached Processor (AP) 3033 configuration packaged in a single box, but with microcode and/or software to provide relatively efficient CPU redundancy (i.e., the machine would continue to run in a degraded mode if one CPU failed).
- If IBM pursues the latter approach, INPUT would predict a price of \$3.5-4.2 million - consistent with 3033N pricing. This concept could be extended across

# EXHIBIT V-3 PROJECTED WHOLESALE VALUES FOR THE IBM 3031 PROCESSOR

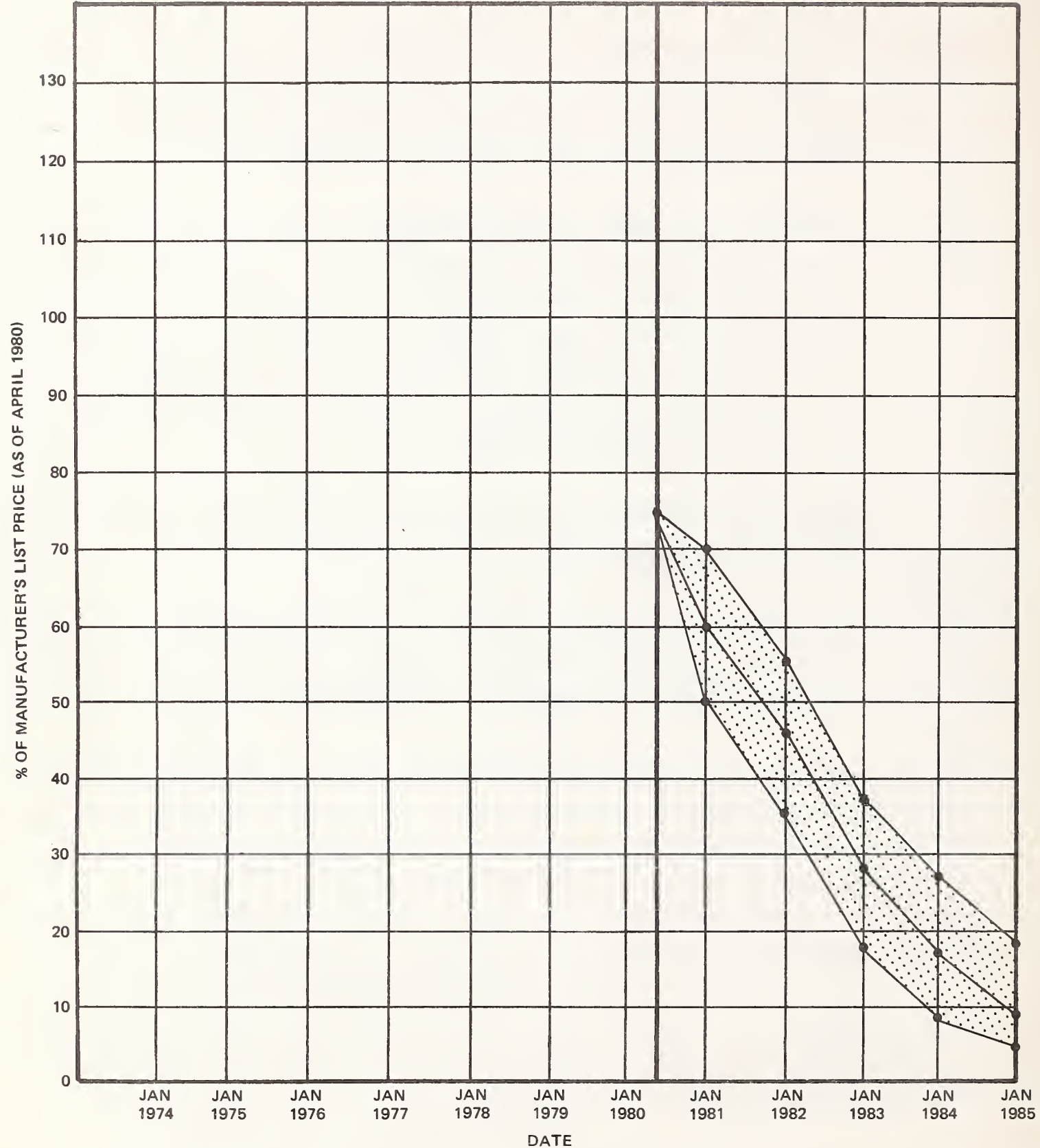


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	70%	55%	37%	27%	17%
EXPECTED	60%	45%	28%	18%	9%
LOW	50%	35%	18%	8%	4%

**EXHIBIT V-4**  
**PROJECTED WHOLESALE VALUES FOR THE**  
**IBM 3032 PROCESSOR**

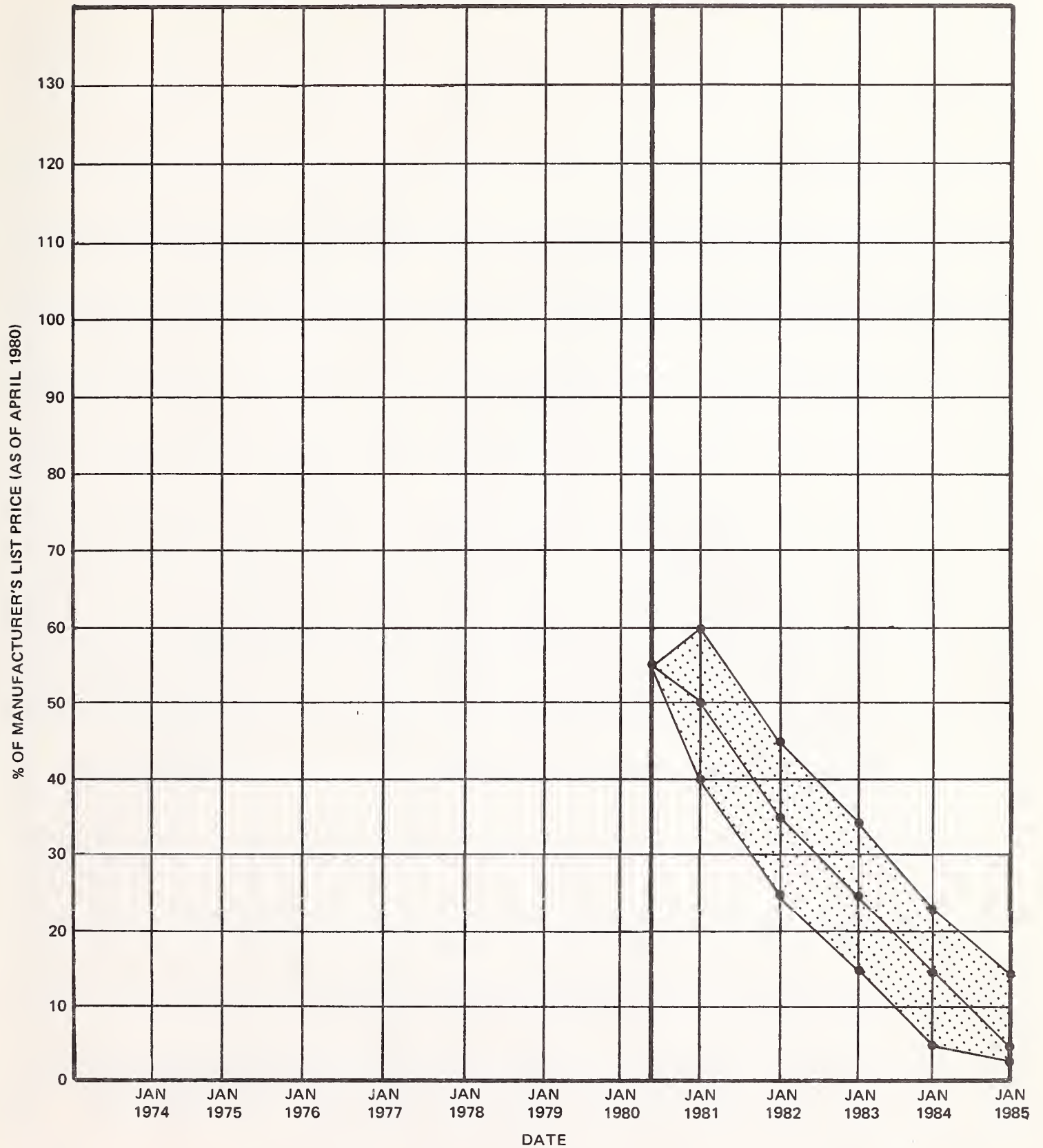


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	60%	45%	34%	23%	15%
EXPECTED	50%	35%	25%	15%	5%
LOW	40%	25%	15%	5%	3%



# EXHIBIT V-5 PROJECTED WHOLESALE VALUES FOR THE IBM 3033N PROCESSOR

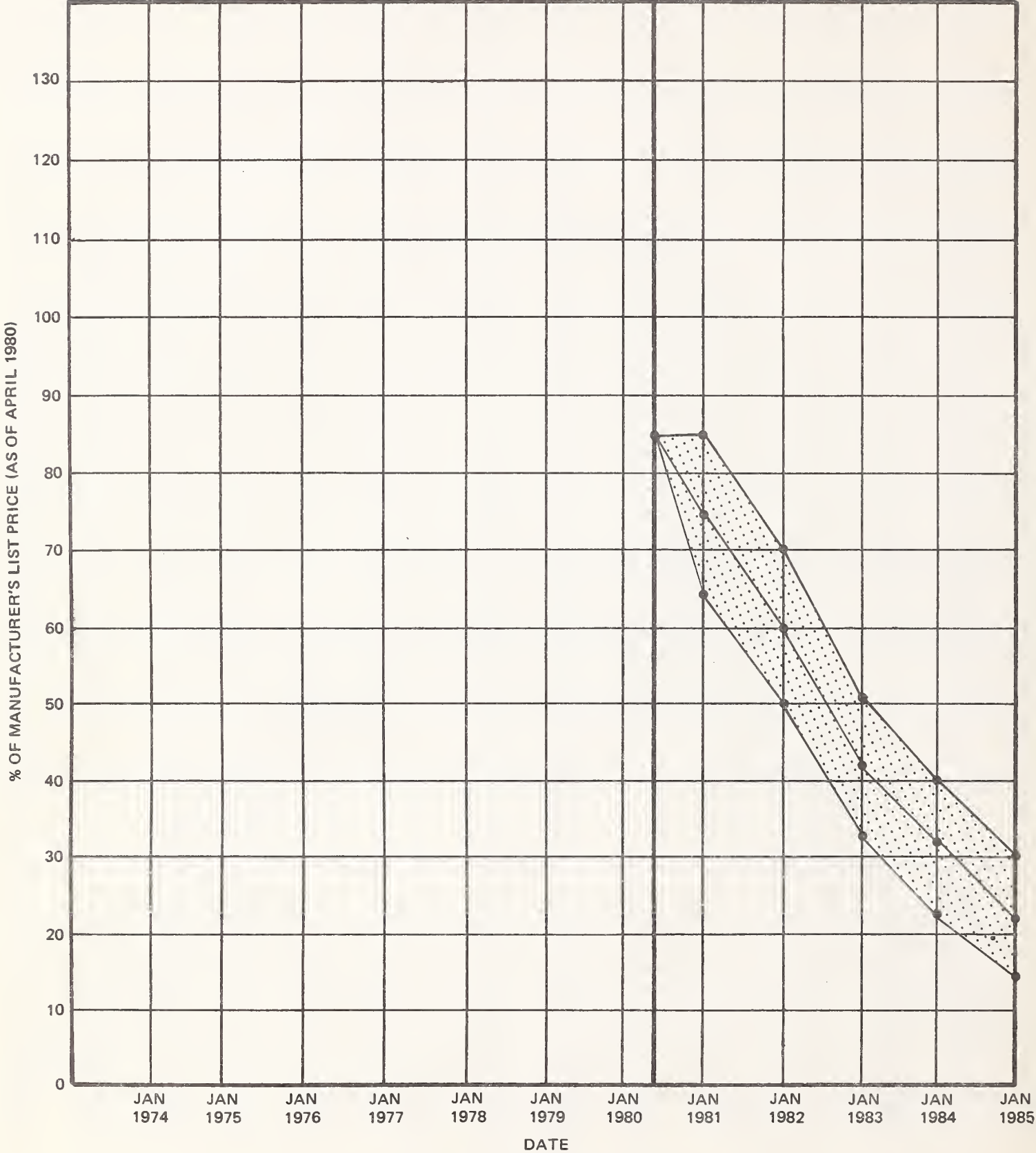


TABLE OF VALUES					
PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	85%	70%	51%	40%	30%
EXPECTED	75%	60%	42%	32%	22%
LOW	65%	50%	33%	23%	15%



**EXHIBIT V-6**  
**PROJECTED WHOLESALE VALUES FOR THE**  
**IBM 3033 PROCESSOR**

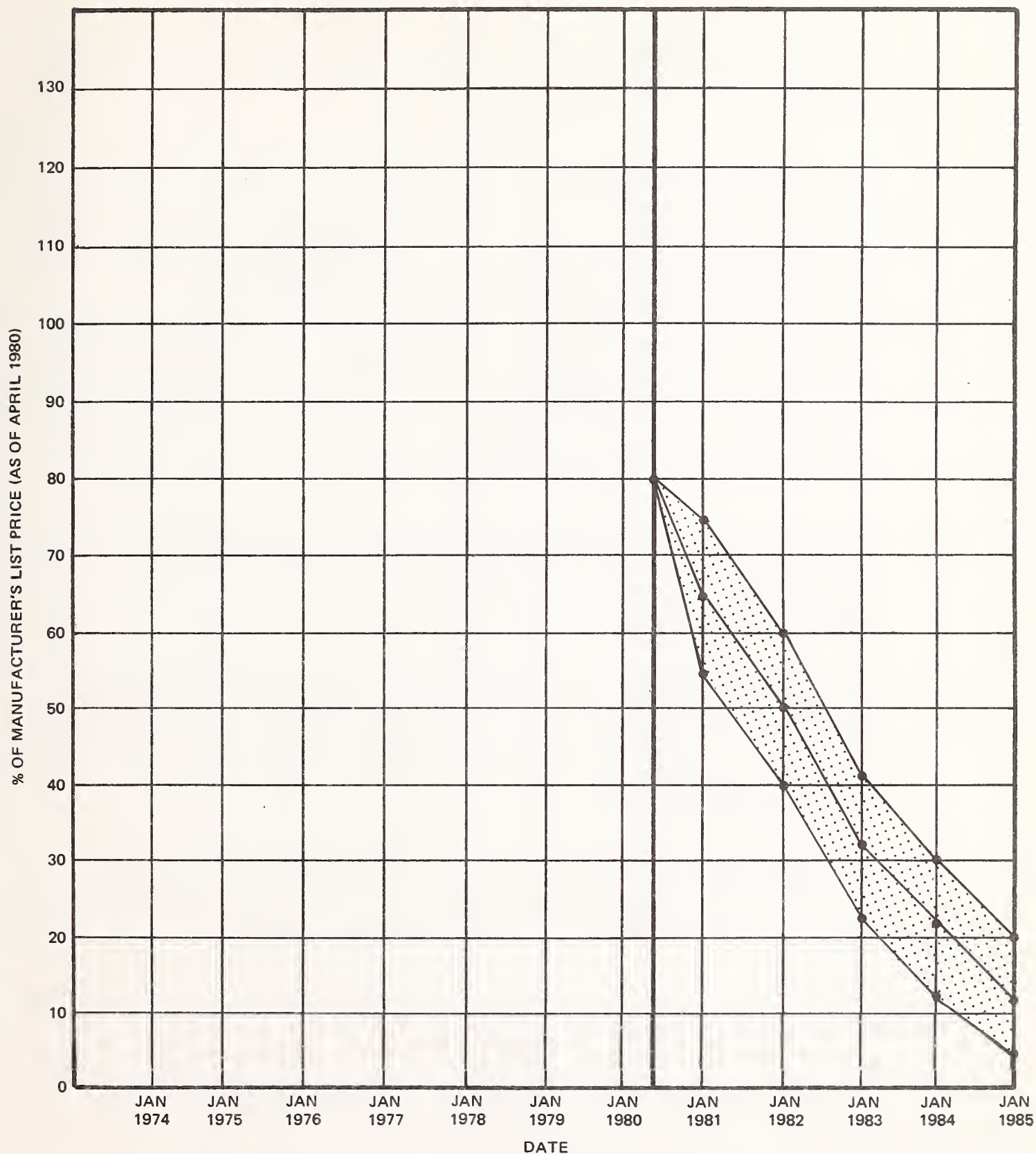


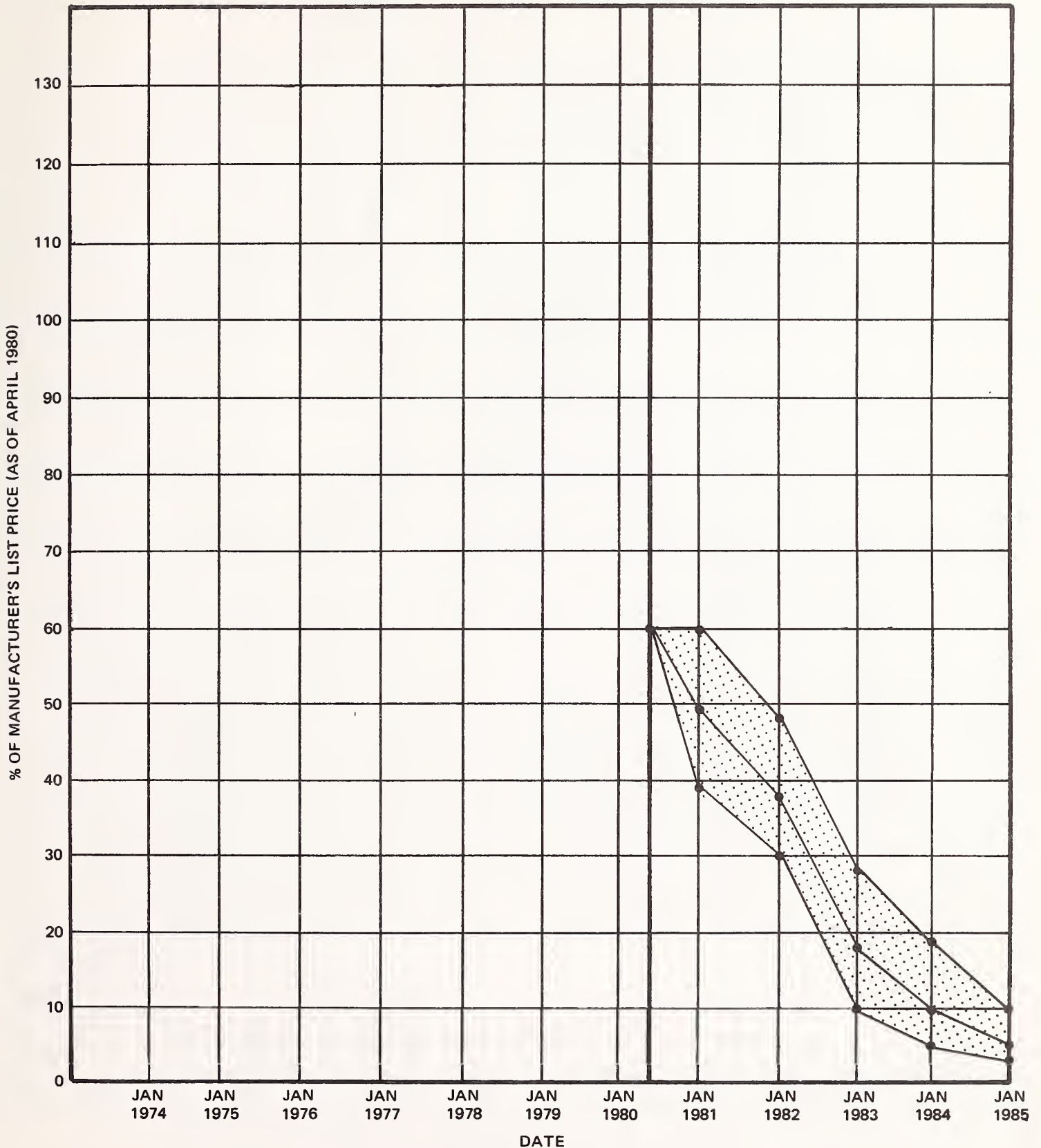
TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	75%	60%	41%	30%	20%
EXPECTED	65%	50%	32%	22%	12%
LOW	55%	40%	23%	13%	5%

the 303X series, providing a very handy way to recycle returned 303X uniprocessors.

- The residual value projections for the 303X series thus assume a modest (10-20%) price reduction for the 3031, 3032, and 3033 before the end of this year. They also assume the major impact of the "H" series (i.e., volume deliveries) will not be seen until the late 1982 to late 1983 timeframe.
- Demand for the 3031 and 3033 processors remains relatively high. The 3032 was selling poorly even before the 3033N announcement. The 3032 should fetch only a small premium over the 168-3 as long as 168s are readily available in the used market and, thus, are a viable alternative.
- Projected values for the Amdahl 470 V/6 family (various models of the V/5 and V/6) and the 470 V/7 family (various models of the V/7 and V/8) are shown in Exhibits V-7 and V-8.
- Few, if any, of the V/6 family of processors are now being manufactured. The V/7 and V/8 are Amdahl's current state of the art product series, and as such their future residual values will remain higher as a percentage of list price than the older V/6 series.
- The slower versions of the V/7 (i.e., the V/7A and V/7B) are the basic V/7, but with part of the cache memory "de-activated" and a shortened instruction pipeline.
- The merger with Storage Technology Corporation (STC) and acquisition of Tran Telecommunications Corporation should provide a much stabler revenue base and make Amdahl less vulnerable to IBM new-product announcements.

# **EXHIBIT V-7** **PROJECTED WHOLESALE VALUES FOR THE** **AMDAHL V/5 AND V/6 PROCESSORS**



**TABLE OF VALUES**

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	60%	49%	28%	19%	10%
EXPECTED	48%	38%	18%	10%	5%
LOW	39%	30%	10%	5%	3%



# EXHIBIT V-8 PROJECTED WHOLESALE VALUES FOR THE AMDAHL V/7 AND V/8 PROCESSORS

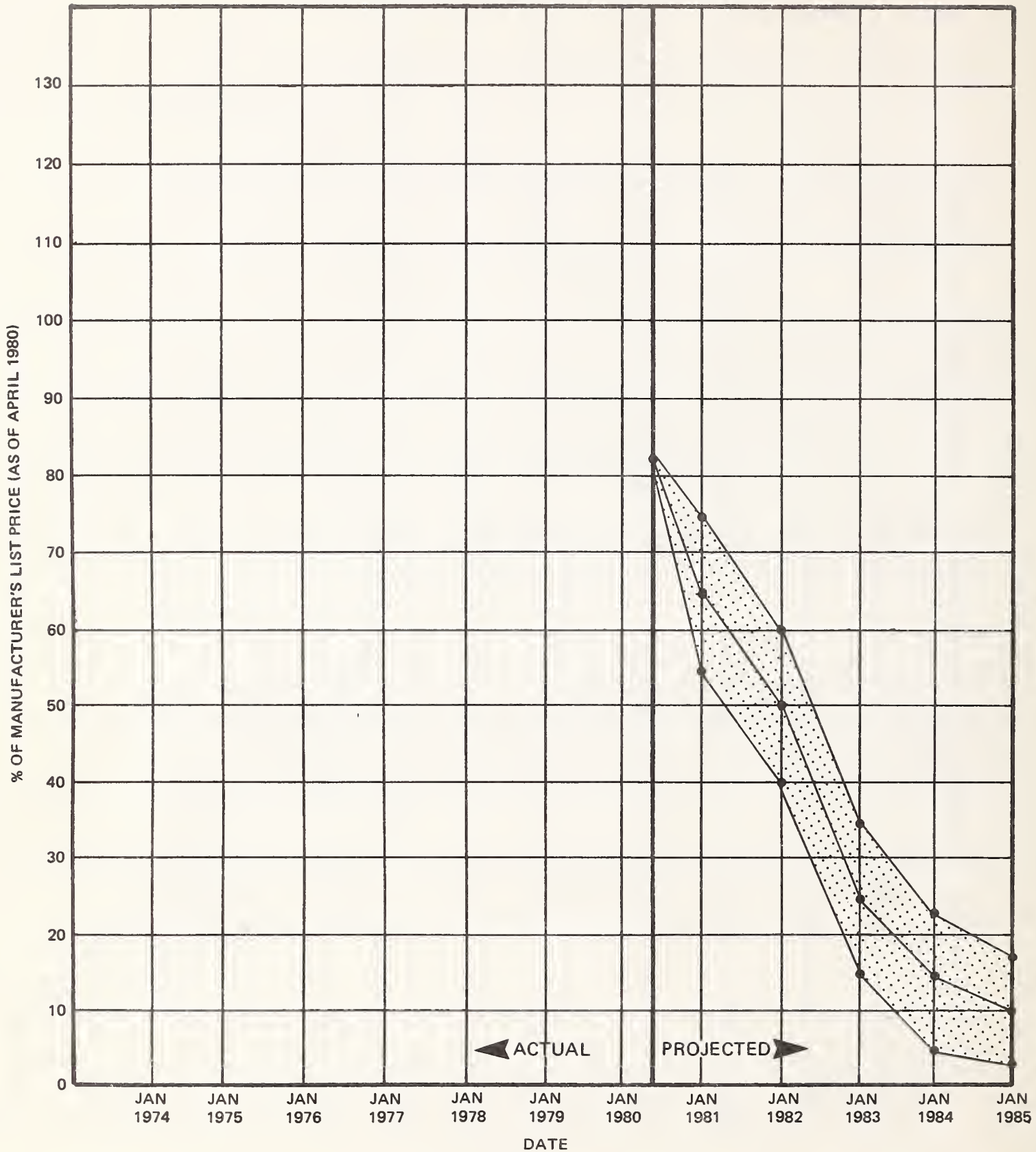


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	75%	60%	35%	23%	18%
EXPECTED	65%	50%	25%	15%	10%
LOW	55%	40%	15%	5%	3%

- Amdahl has been continually strengthening its software expertise and is now offering software - for a fee - outside of its own customer base. The VM/Performance Enhancement - which reduces system overhead significantly when running MVS or SVS under VM - will be available in July of this year to IBM installations.
- Amdahl has been quick to react to IBM product announcements in the past - and is in a position to do so again. A follow-on CPU, probably to be called the V/9, could be announced at any time.
- The secondary market for both Amdahl and National Advanced Systems (NAS) processors is hampered (relative to IBM) by the smaller installed base. Penetrating an IBM site takes effective selling - something many used market dealers are not prepared to undertake. Such dealers prefer to "place" a CPU, not attempt to "sell" it over competing IBM alternatives. This reluctance to handle used Amdahl and NAS processors can only have adverse effects on future residual values.
- Projected values for the NAS AS/5000 CPU and the AS/7000 CPU family (7000N, 7000, and 7000DPC) are shown in Exhibits V-9 and V-10. The projected values assume NAS will provide the level of service and maintenance necessary to keep its installed base satisfied. End user satisfaction levels were excellent when ITEL was the provider. Very few ITEL (now NAS) processors have been offered in the used market - attesting to positive support levels.
- National Semiconductor, the parent of NAS and supplier of the AS/3000 and AS/5000 products, is exploring the feasibility of making very large capacity processors. A project to design and produce a 5 MIPS 3033 class machine was recently terminated. However, investigation of VLSI ten MIPS and higher CPUs as future product offerings continues.
- NAS is also negotiating with Hitachi to develop and offer a product based on the M200 H CPU (an approximately eight MIPS machine). This was

# EXHIBIT V-9 PROJECTED WHOLESALE VALUES FOR THE NAS 5000 PROCESSOR

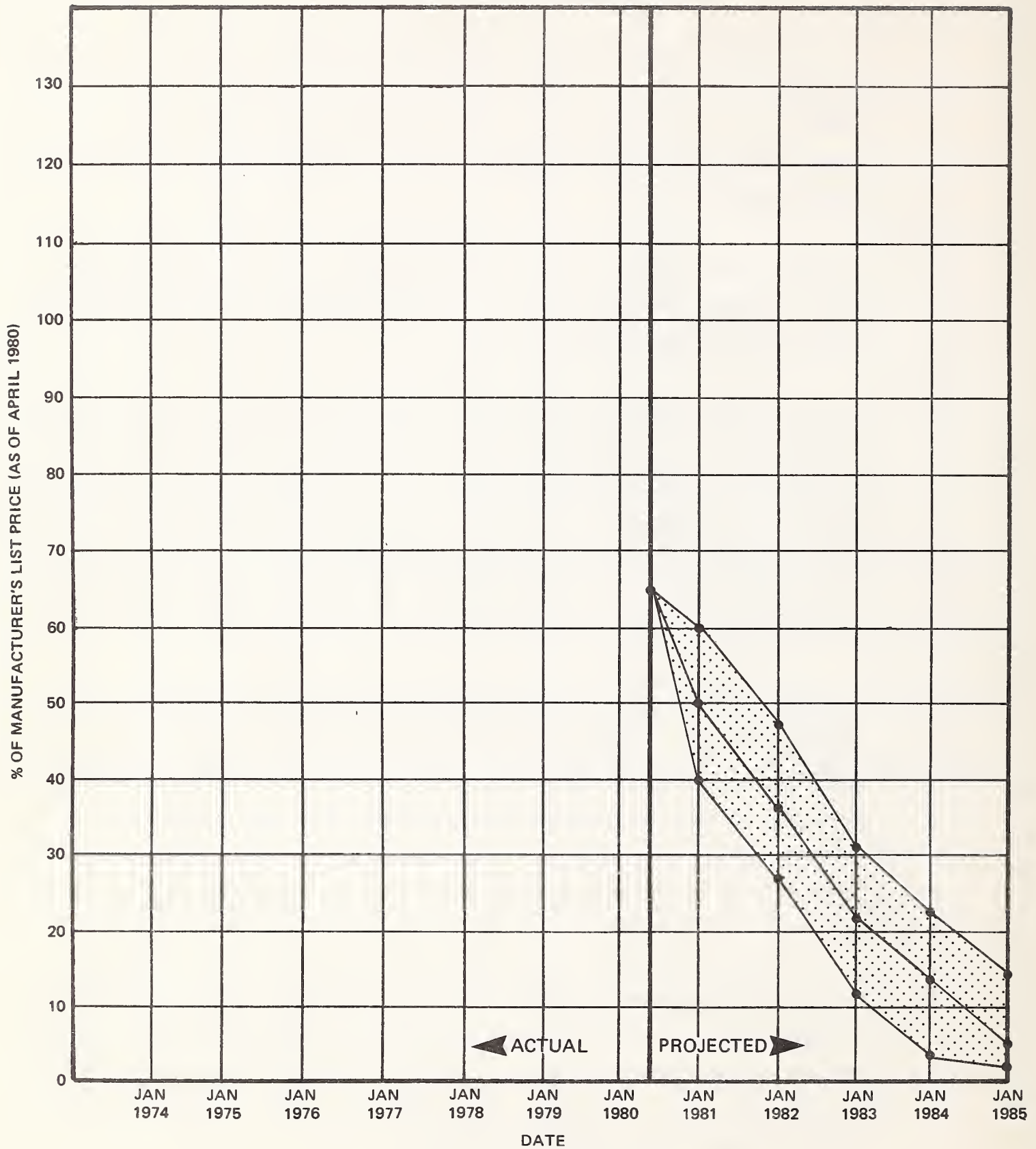


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	60%	47%	31%	23%	15%
EXPECTED	50%	37%	22%	14%	7%
LOW	40%	27%	12%	4%	2%



# EXHIBIT V-10 PROJECTED WHOLESALE VALUES FOR THE NAS 7000 PROCESSOR

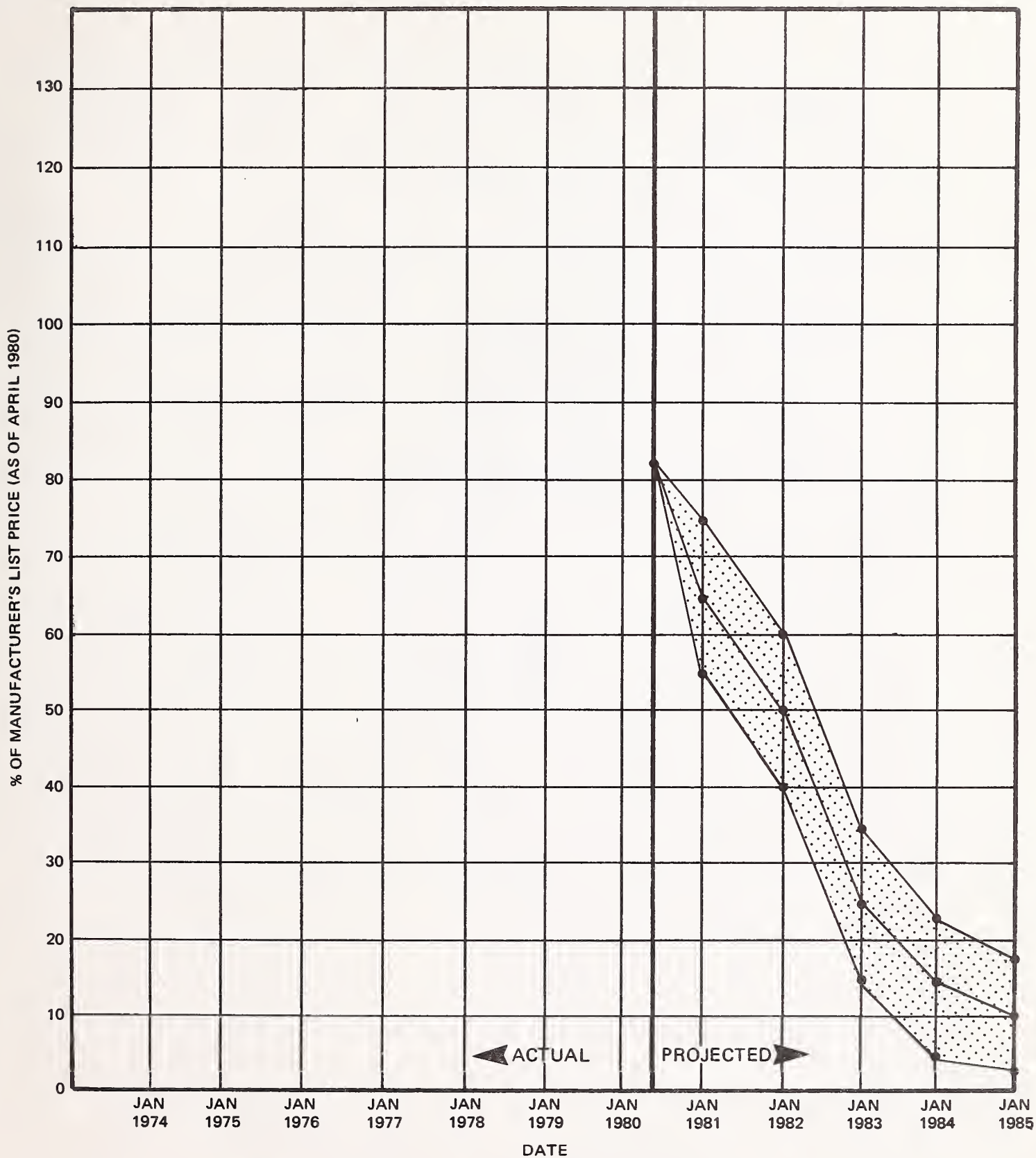


TABLE OF VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985
HIGH	75%	60%	35%	23%	18%
EXPECTED	65%	50%	25%	15%	10%
LOW	55%	40%	15%	5%	3%



"announced" by ITEL as the AS/8, and will likely be "re-announced" at an appropriate time by NAS. The Japanese have become quite sophisticated with VLSI technology and can be expected to develop state-of-the-art products in direct competition to IBM and Amdahl.

- Although very proficient in hardware design and manufacture, the Japanese lack software development strength. Software has not been considered a valuable export item, and thus has not had MITI backing. Computer programming is a low-status job in Japan, and thus talent necessary to develop complex operating systems is difficult to assemble. NAS may have to rely primarily on its own software expertise to provide support to its customer base and to compete effectively in future markets.

**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer & Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Small Establishments Service - Analyzes and forecasts small establishments' (<500 employees) use of office, communication, and computer services and products. Applications requirements and economics and emphasized.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$50,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1978 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have over 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2471 East Bayshore Road  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
Empire House  
414 Chiswick High Road  
London, W4 5TF  
England  
995-5397/8/9  
Telex 896739

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

RESIDUAL VALUE FORECASTS  
FOR IBM MULTIPLATTER, MOVING-  
HEAD DISK STORAGE SYSTEMS

SEPTEMBER 1980



## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Clients of this program receive the following services each year:

- Residual Value Forecasts for IBM Multiplatter, Moving-Head Disk Storage Svstems, providing detailed five-year computer mainframe and
- Verifying the probable moves in operating systems, networks, mass storage, and
- DEveloping long-term plans of ratio data.
- EDiting depth analyses of the managerial, and personnel
- Co-ordinating research staff on an
- Locating references held according
- To specific presentations to
- Ca as
- Pr cli

### RESEARCH MEETINGS

communications

- Re discussions with client
- Re interviews with users, senior analysts.
- Co on the judgement of
- IN
- Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ -7662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Road  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

RESIDUAL VALUE FORECASTS  
FOR IBM MULTIPLATTER, MOVING-  
HEAD DISK STORAGE SYSTEMS

SEPTEMBER 1980





# RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING-HEAD DISK STORAGE SYSTEMS

## ABSTRACT

This report is an update of residual value forecasts for IBM multiplatter, moving-head disk storage systems. Of particular significance is a review of the recently announced 3375 and 3380 disk storage systems, and a presentation of 3370, 3375 and 3380 processor and operating system compatibility. In addition, the history of IBM disk storage products, capacity, access time and pricing is updated.



RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER  
MOVING-HEAD DISK STORAGE SYSTEMS

TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION .....	I
II A REVIEW OF THE IBM 3375 AND 3380 DISK STORAGE PRODUCTS .....	3
III TRENDS IN MOVING-HEAD DISK STORAGE SYSTEMS .....	7
IV RESIDUAL VALUE FORECASTS FOR IBM 3330, 3350, 3370, 3375 AND 3380 DISK STORAGE SYSTEMS .....	13



# RESIDUAL VALUE FORECASTS FOR IBM MULTIPLATTER, MOVING-HEAD DISK STORAGE SYSTEMS

## LIST OF EXHIBITS

			<u>Page</u>
II	-1	Processor Model, Operating System And 3370, 3375 And 3380 Disk Drive Compatibility	5
III	-1	IBM Multiplatter, Moving-Head Disk Storage Products	8
	-2	Comparative Characteristics Of IBM 2314, 3330-II, 3350 And 3370 Disk Drives	9
	-3	IBM Disk Storage Pricing Trend	12
IV	-1	Price History of IBM 3330-I, 3330-II, 3350-B2, 3370-B1, 3375-B1 and 3380-B4 Disk Drives	14
	-2	Residual Value Forecast For IBM 3330-I Disk Drive	16
	-3	Residual Value Forecast For IBM 3330-II Disk Drive	17
	-4	Residual Value Forecast For IBM 3350-B2 Disk Drive	18
	-5	Residual Value Forecast For IBM 3370-B1 Disk Drive	19
	-6	Residual Value Forecast For IBM 3375-B1 Disk Drive	20
	-7	Residual Value Forecast For IBM 3380-B4 Disk Drive	21
	-8	List Purchase Prices For IBM Disk Products (8/80)	22





## I INTRODUCTION

- This report on IBM multiplatter, moving-head disk storage systems is issued as part of the Residual Value Forecast series in INPUT's Planning Service for Computer and Communications Users. These reports are not meant to provide detailed technical analyses of the selected computer peripheral area, but rather an overview useful in equipment acquisition decision making.
- Disk storage capacity has been increasing at 20-40% per year at most large computer sites. The investment in disk storage equipment is thus a significant item in most hardware budgets.
- This report is an update of an initial study on IBM disk systems published in June 1979. The 1979 report provided a historical review of IBM disk storage products, described the role of disk devices in the overall computer system memory hierarchy, and gave residual value forecasts for IBM 3330, 3350 and 3370 disk systems.
- The most significant event since the June 1979 report was the recent announcement (June 1980) of the 3375 and 3380 disk storage products. These new products, which had been widely anticipated for several months prior to their announcement, are reviewed in Section II of this report.
- Section III describes recent trends and expected future developments in the moving-head disk storage area.

- Section IV provides forecasts of residual values for IBM 3330, 3350, 3370, 3375 and 3380 disk storage products. Used market retail selling prices for earlier periods are included where such data are available.

## II A REVIEW OF THE IBM 3375 AND 3380 DISK STORAGE PRODUCTS

- On June 11, 1980, IBM announced two new disk storage systems:

<u>Model Number</u>	<u>Unit Capacity (Megabytes)</u>	<u>Average Access Time (Milliseconds)</u>	<u>Data Rate (Megabytes/ Second)</u>
3375	819.7	19	1.86
3380	2520.0	16	3.00

- Like the 3370 disk product (announced May 1979 and described in some detail in INPUT's June 1979 report), the 3375 and 3380 use thin-film, read/write heads.
- This new technology, described in greater detail in the next section, allows significant increases in the areal density; i.e., the number of bits that can be recorded or read per square inch of disk surface. The new thin-film head products have areal densities of 2.5 to 3.0 times that of IBM's 3350 disk drive, which uses conventional wire coil ferrite heads.
- Unlike the 3370, the 3375 and 3380 use traditional count-key data formatting. The 3370 introduced fixed block architecture (FBA), which transfers information to and from the disk device in 512-byte increments. This approach provides some attractive advantages over the count-key data method; however, conversion efforts would have been very great for many end users. It is likely that FBA will be supported in 3375 and 3380 disks, and that conversion aids will be developed.

- Both the disk devices themselves and the control unit required to attach them to the processor contain high-performance microprocessors. Thus there is future flexibility in linking various disk units to various processor models under various operating systems. The current limitations are shown in Exhibit II-1.
- First customer shipment schedules are:
  - 3375: Third Quarter 1981.
  - 3380: First Quarter 1981.
  - It should be noted, however, that for 370/158 and 370/168 processors, the required speed-matching buffer to attach 3380 disks is not available until Third Quarter, 1981.
- The channels on 303X processors must be modified to accommodate data rates of above 1.5 megabytes/second. This modification is called the data streaming feature. It costs \$40,000 and increases the maximum allowed data rate from 1.5 to 3.0 megabytes/second on the first two channels of a channel group (i.e., per channel director). Channels on 370/158 and 370/168 processors cannot be modified.
- Operation of the disk units at 1.5 megabytes/second (on 303X or 158/168 processors) requires the speed-matching buffer feature on the 3880 control unit (cost = \$9,500). However, with this feature (and the appropriate 3880 model number), it is possible to access multiple processors with both 1.5 and 3.0 megabyte/second channels.
- The general architecture of the 3375 and 3380 differs slightly from the 3350.
  - Four units comprise a string, with a head of string unit with some of the controller functions.

# EXHIBIT II-1

## PROCESSOR MODEL, OPERATING SYSTEM AND 3370, 3375 AND 3380 DISK DRIVE COMPATIBILITY

OPERATING SYSTEM	PROCESSOR MODEL					
	4331	4331-2	4341	3031	3032, 3033	158, 168
DOS/VSE	<div> <div>3370</div> <div>3375</div> </div>					
OS/VSI	<div>3375</div>					
MVS/SP	<div> <div>3375</div> <div>3380</div> </div>					
ACP	<div>3380</div>					
VM/SP	<div> <div>3370</div> <div>3375</div> <div>3380</div> </div>					

- Some fixed head capacity is available (optional).
- There are two actuators per disk spindle (the 3375 has one disk spindle per unit, the 3380 has two).
- A new feature for IBM is a "dynamic path selection" which plug compatible manufacturers (PCMs) have offered for years. PCMs generally refer to it as dual-port capability. This feature permits two separate paths to each actuator from separate channels.
- Compared to the 3350, the physical and environmental improvements are notable:
  - Floor space savings of 65%.
  - Power consumption reduction of 70%.
  - Heat generation reduction of 75%.
- In summary, these new products are evolutionary in nature, and many of the features and operating characteristics were predicted in the trade press prior to announcement. IBM has a definite leadership position in thin-film head technology, but others have active programs (including the Japanese) and will not be far behind. The lack of FBA and the ability to attach to 370/158 and 370/168 processors together imply that IBM's next processor generation is not imminent.



### III TRENDS IN MOVING-HEAD DISK STORAGE SYSTEMS

- IBM introduced the first multiplatter, moving-head disk storage product in 1956. Since then, nine evolutionary product generations have been announced. Exhibit III-1 lists these products and compares capacity in megabytes (MB), average access time in milliseconds, and rental cost per megabyte (average cost per string member, excluding controller, at time of announcement).
- Exhibit III-2 provides comparative characteristics of selected disk product "families" - the 2314, 3330, 3350 and 3370 groups.
  - The 2314 disk product was the industry standard during the 1960s and was designed for the 360 series processors.
  - The 3330 was developed for the 370 series processors. Like the 2314, it used removable disk packs.
  - The 3350 employed "winchester" technology; i.e., the mating of the read/write heads with the magnetic media in a sealed package.
  - The 3370 represented the first use of thin-film, read/write heads.
- The performance of a disk drive is dependent on how quickly the data can be located (average access time) and how quickly the data can be transferred (data rate). Both are sensitive to the areal density (the number of bits that can be recorded or read per square inch of disk surface).



# EXHIBIT III-1

## IBM MULTIPLATTER, MOVING-HEAD DISK STORAGE PRODUCTS

IBM STORAGE DEVICE	YEAR ANNOUNCED	CAPACITY (MB)	AVERAGE ACCESS TIME (MILLI- SECONDS)	RENTAL COST /MB
305	1956	5.0	650	\$150.00
2311	1964	7.3	110	75.00
2314	1965	29.1	60	25.00
3330-1	1970	100.0	30	8.00
3330-11	1973	200.0	30	5.00
3340	1973	70.0	25	7.50
3350	1975	317.0	25	2.50
3370	1979	571.3	20	1.50
3375	1980	820.0	19	1.16
3380	1980	2520	16	0.88

EXHIBIT III-2

COMPARATIVE CHARACTERISTICS OF IBM  
2314, 3330-11, 3350 AND 3370 DISK DRIVES

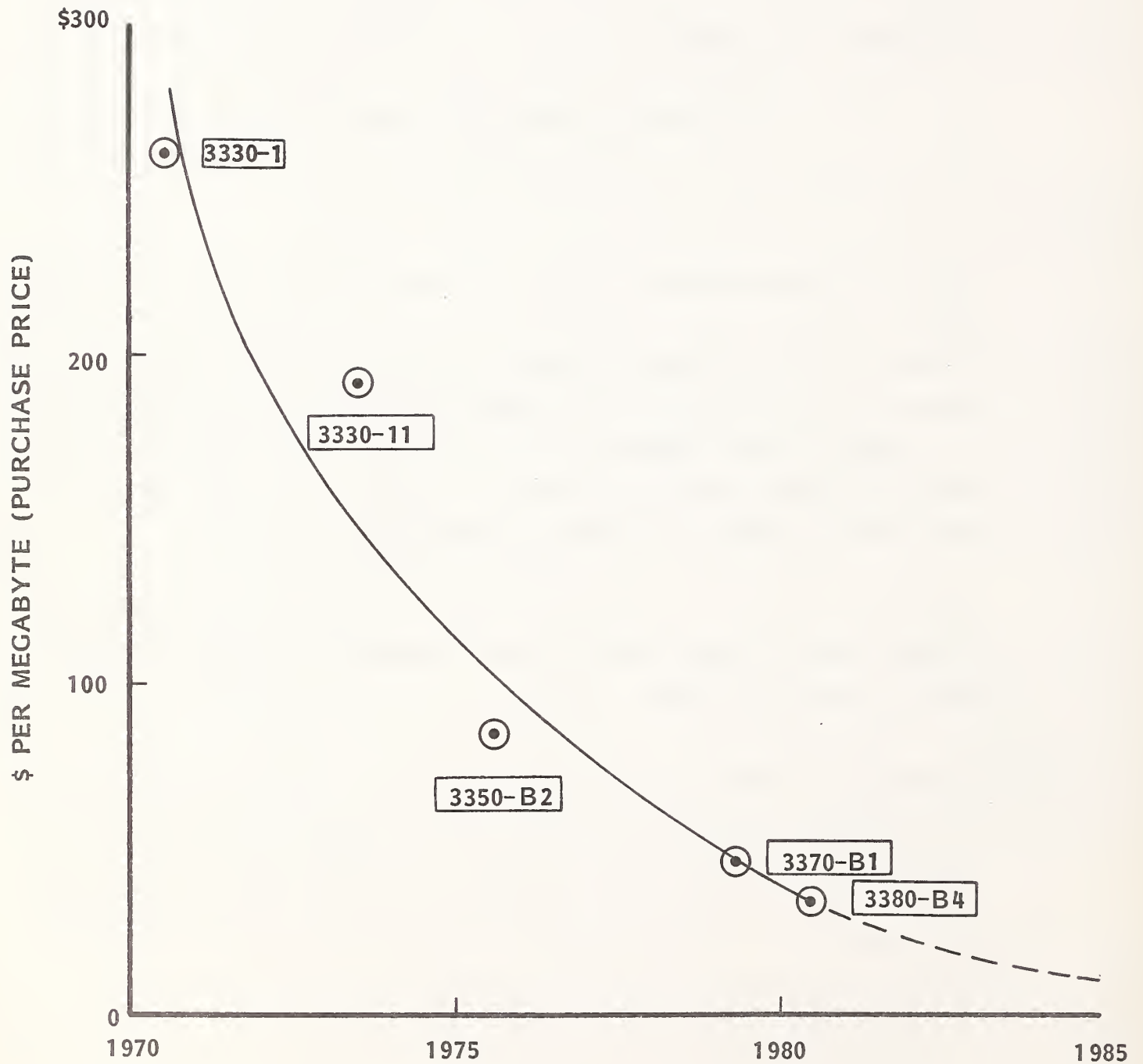
IMPROVEMENT AREA	2314 DEVICE (ANNOUNCED 1965)	3330-11 DEVICE (ANNOUNCED 1973)	3350 DEVICE (ANNOUNCED 1975)	3370 DEVICE (ANNOUNCED 1979)
HEAD POSITIONING	HYDRAULIC ACTU- ATOR WITH MECHAN- ICAL TRACK HOLD	VOICE COIL ACTU- ATOR WITH ELEC- TRONIC TRACK HOLD	VOICE COIL/ROTARY ACTUATOR WITH ELECTRONIC TRACK HOLD	VOICE COIL/ROTARY ACTUATOR WITH ELECTRONIC TRACK HOLD
HEAD FLYING HEIGHT	100 MICROINCHES	45 MICROINCHES	20 MICROINCHES	15 MICROINCHES
MEDIA	NONORIENTED MAGNETIC	NONORIENTED MAGNETIC	ORIENTED MAGNETIC	ORIENTED MAGNETIC
ROTATIONAL SPEED	2400 RPM	3600 RPM	3600 RPM	3600 RPM
DATA TRANSFER RATE (MEGA- BYTE/SECOND)	312	809	1198	1860
AREAL DENSITY (BITS/SQUARE INCH)	220,000	1,500,000	3,058,000	7,800,000

- The cost of data stored (usually given per million characters; i.e., megabyte) is also sensitive to the areal density. Thus much attention has been, and will be, directed towards increasing areal density.
- Areal density can be increased by:
  - Increasing the number of magnetic flux changes achievable along the linear distance of the track (a function of the read/write head sensitivity, the distance between the head and the moving magnetic media, and the magnetic "strength" of the media).
  - Decreasing the distance between adjacent tracks (i.e., increasing the number of tracks per inch, a function of the read/write head dimensions and the precision of the head positioning equipment).
- The 3350 disk product has a linear density of 6,400 bits per inch (bpi), with 480 tracks per inch. The 3370 disk product, using thin-film heads, has a linear density of 12,000 bpi with 650 tracks per inch. The current maximum density in a working product has been developed by some ex-IBM people who formed Dastek Corporation and are marketing a disk drive with a linear density of 12,772 bpi, with 694 tracks per inch.
- Some improvements in thin-film head design are possible and these will lead to further increases in areal density. With thin-film heads, the inductive circuit is created by depositing a conductive metal (permalloy - a mixture of nickel and iron) in the form of a spiral on a silicon substrate. Thin-film head technology provides the following important advantages over conventional wire-wound ferrite core heads:
  - Greater precision and reproducibility of critical head dimensions. Through use of photolithographic techniques (originally developed for computer chip manufacture), the ability to create and reproduce in quantity heads with very tiny interwinding distances and read/write gap distances is possible.

- Ability to tolerate very high data rates. Conventional heads begin to break down when the number of flux changes per second approaches 10 million. The permalloy used in thin-film heads can tolerate up to 100 million flux changes per second.
- The next major advance in moving-head disk storage capacity will come from new media. Iron-oxide-based disk surface coatings will be replaced by metallic coatings of higher magnetic potential. Such disk surfaces have been created in the laboratory by bombarding a metal target - such as cobalt - with argon gas ions. The ions kick out cobalt atoms, which deposit as a very thin film on a host surface. Such media could be incorporated in the next generation of disk products (1983 timeframe).
- Research is also progressing on new techniques for storing bits in the media, such as layering them perpendicular to the plane of the disk. Thus the read/write head would detect multiple bits when passing over a given point on the disk surface. This could lead to linear track densities approaching 100,000 bpi. Improvements in head positioning actuators and shrinkage in head dimensions could lead to track densities of 1,000 per inch - and thus an overall areal density approaching 100 million bits per square inch.
- Exhibit III-3 charts the purchase cost per megabyte for various IBM disk products. A reasonable continuation of historical trends leads to a figure of \$10 per megabyte by 1985.
- Advancements continue in both bubble memory and optical disk technologies. Current predictions are that both will seriously challenge magnetic disk as the primary random access storage medium in the late 1980s. They are not expected to seriously affect the projections of residual values presented in the next section.

EXHIBIT III-3

IBM DISK STORAGE PRICING TREND





#### IV RESIDUAL VALUE FORECASTS FOR IBM 3330, 3350, 3370, 3375 AND 3380 DISK STORAGE SYSTEMS

- The three principal forces influencing the residual values of IBM disk products have been:
  - New product announcements.
  - Price reductions on existing products.
  - Availability, either new from IBM or in the used market.
- In the past decade, new disk product announcements have appeared every two to four years. Each product has provided greater storage capacity per spindle, higher data transfer rates and better RAS (reliability, availability and serviceability) compared to previous generations. This trend is expected to continue through the 1980s.
- Price changes have followed a less predictable pattern. As shown in Exhibit IV-1, price reductions were more frequent and more aggressive in the second half of the 1970s as IBM adjusted to plug compatible competition.
- IBM currently retains a technological edge in the thin-film area and does not expect competition in the near term. It has thus increased 3370 purchase prices twice since the thin-film head product was announced in February 1979.

# EXHIBIT IV-1

## PRICE HISTORY OF

IBM 3330-1, 3330-11, 3350-B2, 3370-B1, 3375-B1 AND 3380-B4 DISK DRIVES

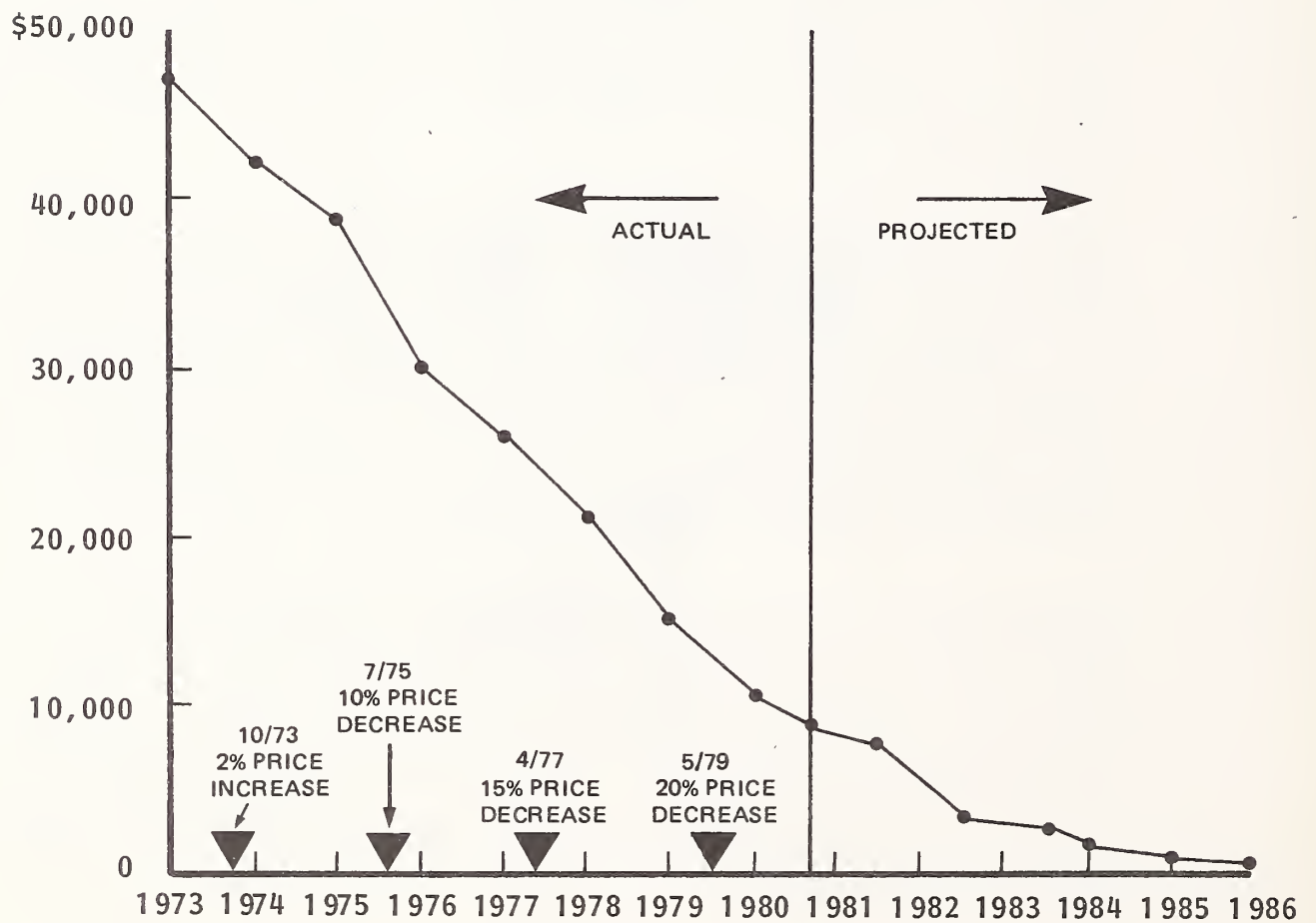
1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
<div>3330-1</div> <div>200 MB</div> <div>(6/70)</div> <div>\$51,940</div> <div>\$260/MB</div>			<div>(10/73)</div> <div>\$52,900</div> <div>\$265/MB</div> <div>3330-11</div> <div>400 MB</div> <div>(7/73)</div> <div>\$74,000</div> <div>\$185/MB</div> <div>(10/73)</div> <div>\$75,400</div> <div>\$189/MB</div>		<div>(7/75)</div> <div>\$47,610</div> <div>\$238/MB</div>		<div>(4/77)</div> <div>\$40,470</div> <div>\$202/MB</div>		<div>(5/79)</div> <div>\$32,380</div> <div>\$162/MB</div>		
					<div>(7/75)</div> <div>\$67,860</div> <div>\$170/MB</div>		<div>(4/77)</div> <div>\$57,610</div> <div>\$144/MB</div>		<div>(5/79)</div> <div>\$46,090</div> <div>\$115/MB</div>		
					<div>3350-B2</div> <div>635 MB</div> <div>(7/75)</div> <div>\$49,500</div> <div>\$78/MB</div>			<div>(10/78)</div> <div>\$39,600</div> <div>\$62/MB</div>	<div>(5/79)</div> <div>\$31,680</div> <div>\$50/MB</div>		
									<div>3370-B1</div> <div>571 MB</div>	<div>(6/80)</div> <div>\$25,790</div> <div>\$45/MB</div>	
								<div>(2/79)</div> <div>\$23,400</div> <div>\$41/MB</div> <div>(12/79)</div> <div>\$24,570</div> <div>\$43/MB</div>		<div>3375-B1</div> <div>820 MB</div> <div>(6/80)</div> <div>\$31,000</div> <div>\$38/MB</div>	
										<div>3380-B4</div> <div>2520 MB</div> <div>(6/80)</div> <div>\$81,000</div> <div>\$32/MB</div>	



- Lease prices for 3330, 3340, 3350 and 3370 products were increased by 7% in early 1980. These price increases, which were counter to a downward trend in disk product pricing stretching back several years, had a noticeably positive impact on used market values.
- Competitive pressures will likely dictate when a significant price reduction on existing products will occur. PCM competition in the thin-film head area is perhaps 18-24 months away. IBM has historically priced its disk products to encourage conversion to purchase when fully accrued (50% of current list price). The 3350 is attractively priced when fully accrued purchase options are applied (e.g., a 3350-B2 would cost \$25/megabyte versus \$32/megabyte to purchase a new 3380-B4), although investment tax credit and warranty considerations, as well as the life cycle value of reduced space requirements, reduced power consumption, and less heat generation, must be evaluated in judging relative value.
- Product availability (i.e., supply versus demand) strongly influences used market pricing. A buffering effect is created by dealers buying for inventory; but, in general, the supply-versus-demand balance dictates market values. Currently 3350 disks are in short supply, and, as a result, prices have risen to near equivalent new pricing (i.e., 80-85% of list price, the difference due to investment tax credit and warranty effects).
- Volume delivery of 3375 and 3380 disks should lead to an influx of 3330 and 3350 products into the used market. There is normally, however, a delay caused by capacity replenishment. End users will typically stretch their "reserve capacity" when definite ship dates for a new generation are known, and may find it necessary to retain installed disk capacity until a steady state position is again reached.
- Exhibits IV-2 through IV-7 provide residual value projections for IBM 3330-I, 3330-II, 3350-B2, 3370-B1, 3375-B1 and 3380-B4 disk products. Projections are provided for the simplest member of each family group. Calculations for other family members can be made by referring to Exhibit IV-8, which

## EXHIBIT IV-2

### RESIDUAL VALUE FORECAST FOR IBM 3330-1 DISK DRIVE (PRODUCT ANNOUNCED JUNE 1970 WITH A PURCHASE PRICE OF \$51,940)



# EXHIBIT IV-3

## RESIDUAL VALUE FORECAST FOR IBM 3330-11 DISK DRIVE (PRODUCT ANNOUNCED JULY 1973 WITH A PURCHASE PRICE OF \$74,000)

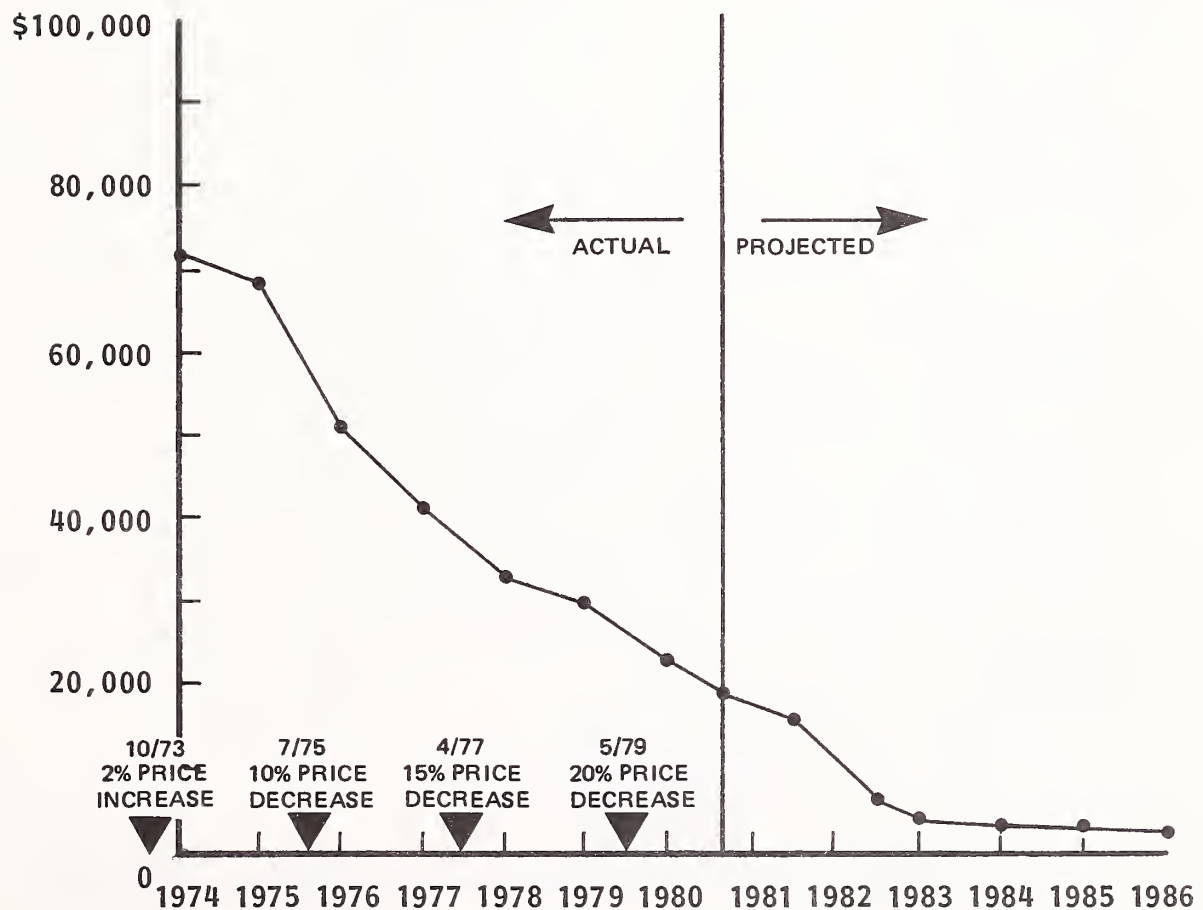


EXHIBIT IV-4

RESIDUAL VALUE FORECAST FOR IBM 3350-B2 DISK DRIVE  
(PRODUCT ANNOUNCED JULY 1975 WITH  
A PURCHASE PRICE OF \$49,500)

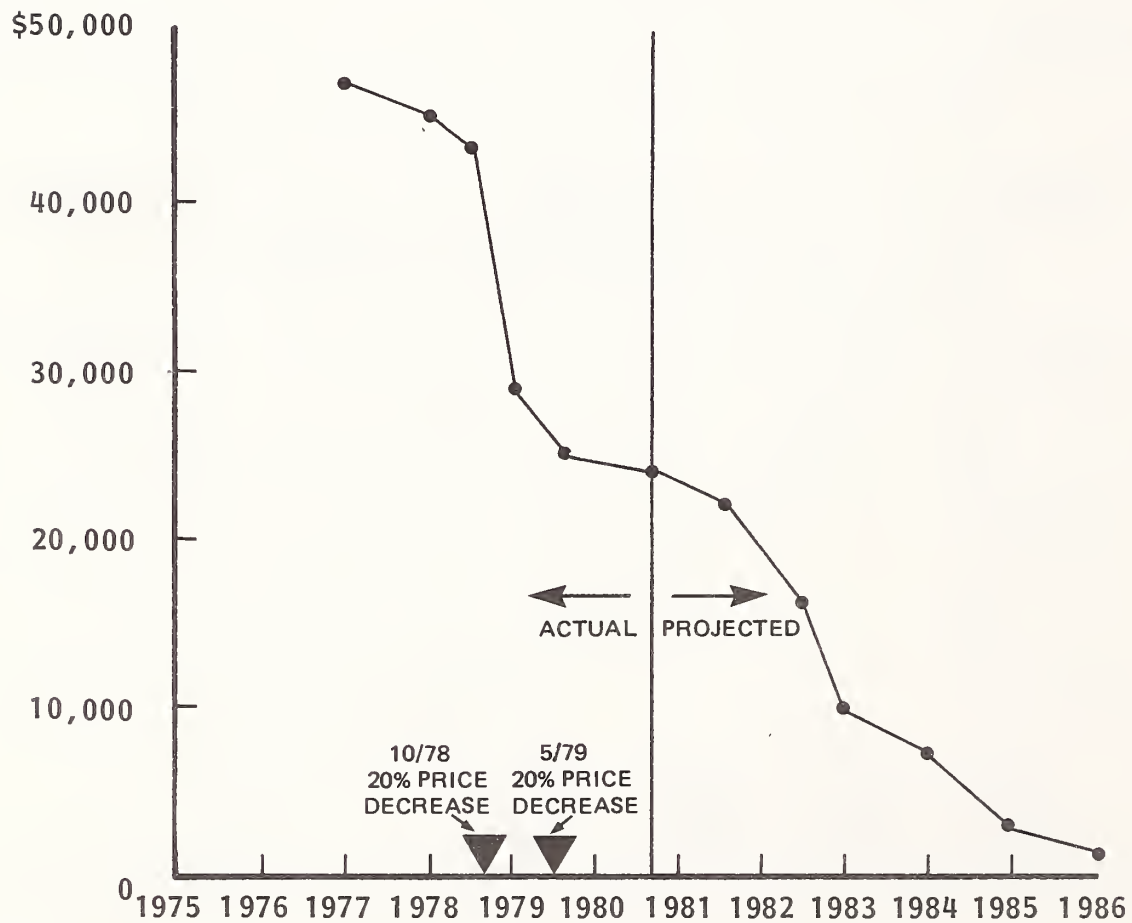


EXHIBIT IV-5

RESIDUAL VALUE FORECAST FOR IBM 3370-B1 DISK DRIVE  
(PRODUCT ANNOUNCED MAY 1979 WITH  
A PURCHASE PRICE OF \$23,400)

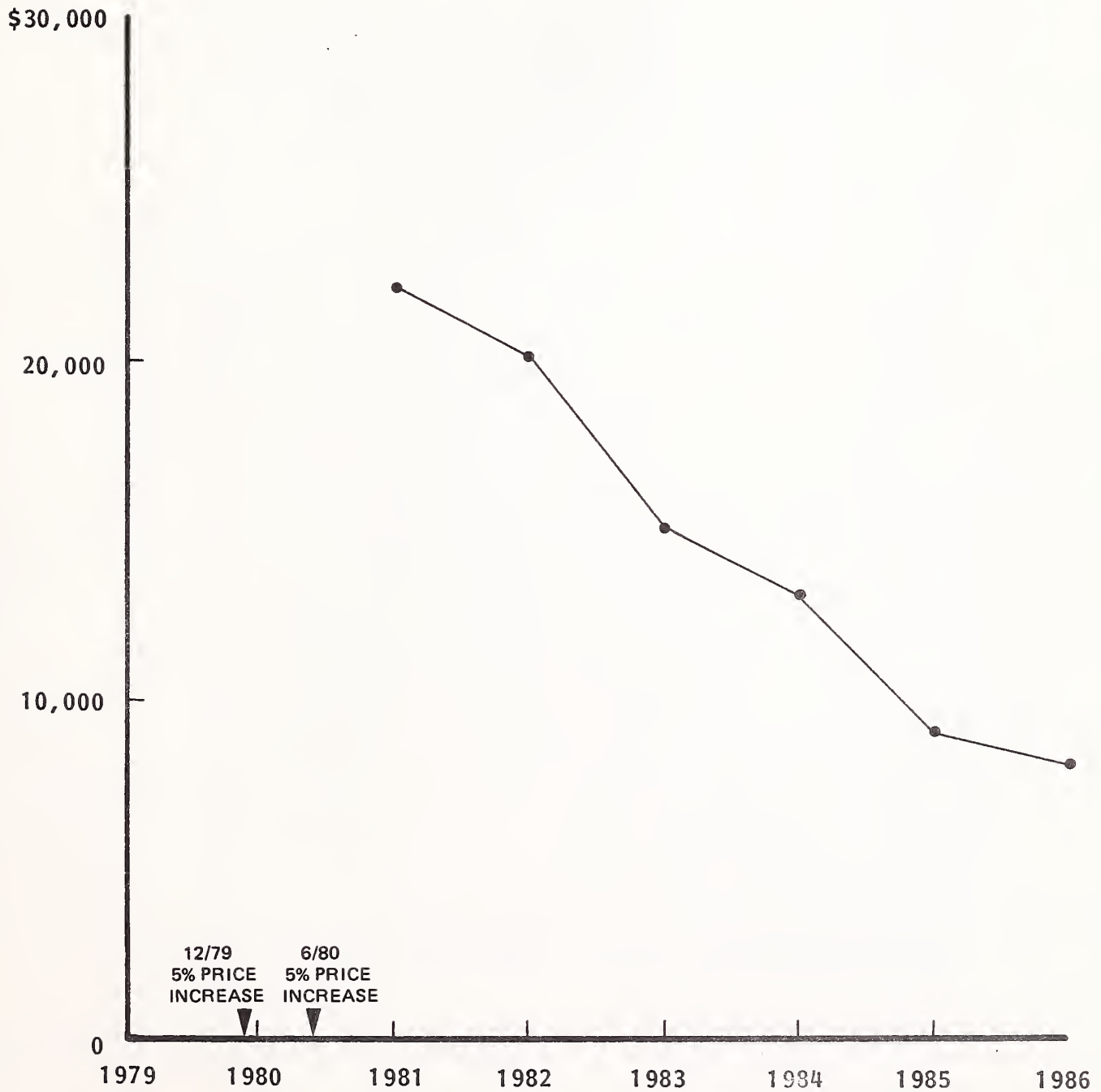


EXHIBIT IV-6  
RESIDUAL VALUE FORECAST FOR IBM 3375-B1 DISK DRIVE  
(PRODUCT ANNOUNCED JUNE 1980 WITH  
A PURCHASE PRICE OF \$31,000)

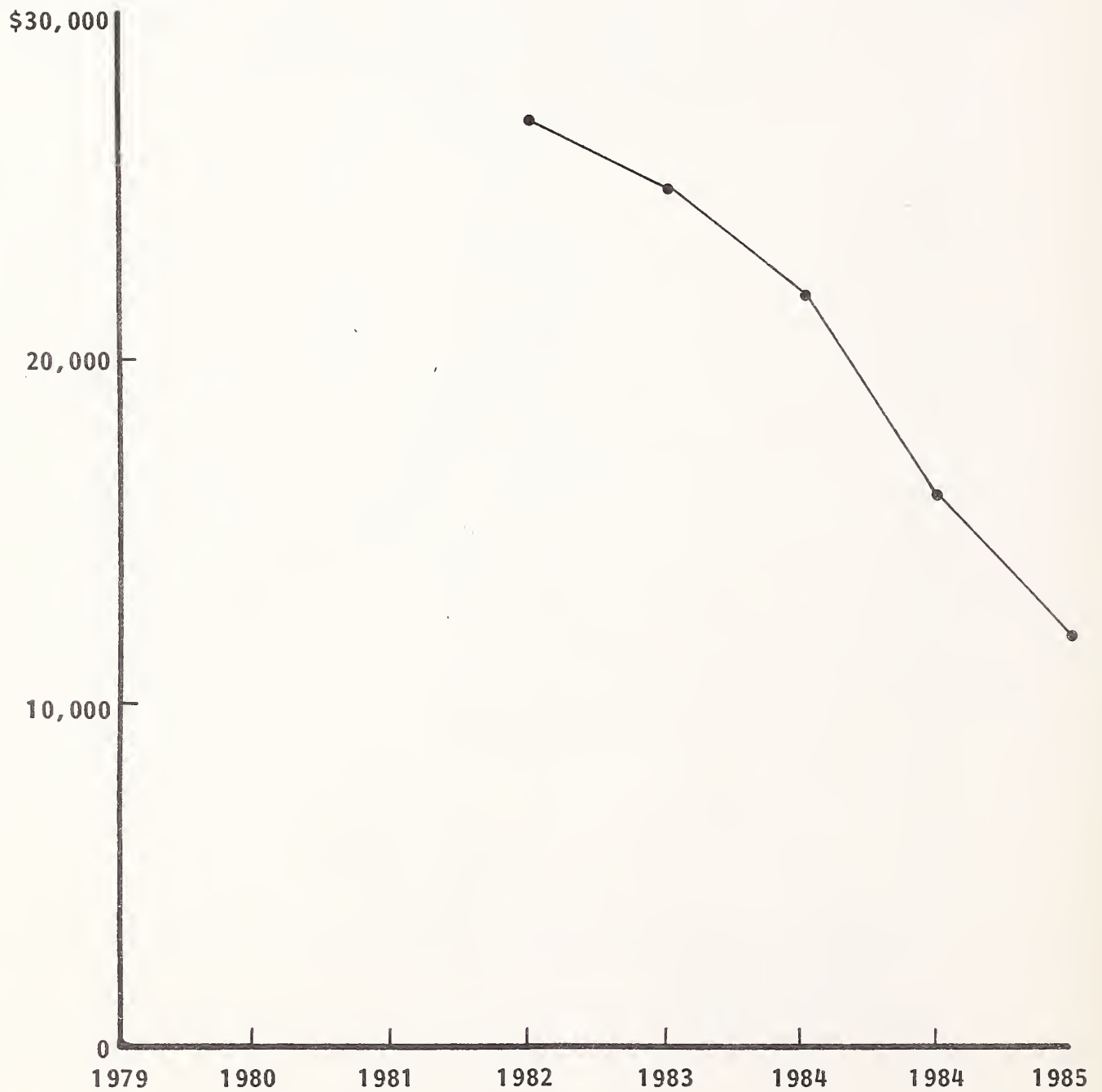
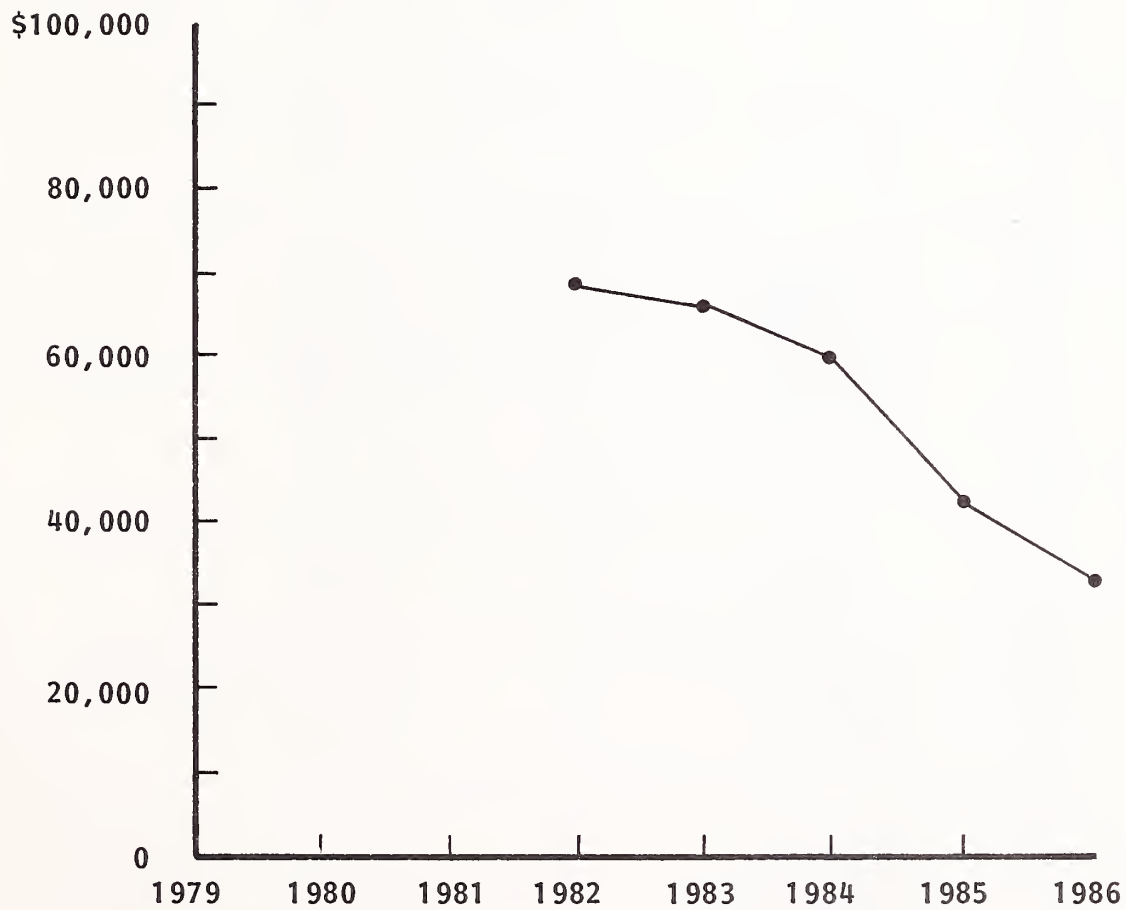


EXHIBIT IV-7

RESIDUAL VALUE FORECAST FOR IBM 3380-B4 DISK DRIVE  
(PRODUCT ANNOUNCED JUNE 1980 WITH  
A PURCHASE PRICE OF \$81,000)





# EXHIBIT IV-8

## LIST PURCHASE PRICES FOR IBM DISK PRODUCTS (8/80)

PRODUCT	PURCHASE PRICE
3330-1 3333-1	\$ 32,380 40,580
3330-11 3333-11	46,090 54,290
3350-A 2 3350-A 2F 3350-B 2 3350-B 2F 3350-C 2 3350-C 2F	40,000 49,920 31,680 41,600 41,380 51,300
3370-A 1 3370-B 1	38,690 25,790
3375-A 1 3375-B 1	46,450 31,000
3380-A 4 3380-A 4F 3380-AA 4 3380-AAF 3380-B 4 3380-B 4F	97,650 128,250 111,600 142,200 81,000 111,600

provides pricing for them. It is assumed that residual values for other members of a given product family will be proportional to the ratio of the respective list prices. For example, the forecasted residual value of the 3350 B2 (list price \$31,680) at the end of 1983 is \$7,500 (see Exhibit IV-4). The forecasted value at that same point in time for the 3350 A2 (list price \$40,000) would be:

$$\frac{\$40,000}{\$31,680} \times \$7,500 = \$9,470$$

- It is important to note that the projected values are the expected retail price in the used market. At any given point in time, three price levels exist. These are:
  - Retail Price - the amount an end user would pay for the equipment.
  - Dealer Price - the amount a dealer or broker (a dealer will buy for inventory, a broker acts solely as a middleperson between buyer and seller) would pay another dealer to acquire equipment to complete a contracted sale obligation.
  - Wholesale Price - the amount a dealer/broker would pay an end user to acquire the equipment.
- As an example, in mid-August 1980, the respective prices for a 3330-11 disk drive were:
  - . Retail = \$20,500.
  - . Dealer = \$18,000.
  - . Wholesale = \$15,000.

- Actual market prices for 3330 and 3350 disks have been higher than INPUT projected in June 1979. The IBM price increases and stronger-than-expected demand has strengthened the used market considerably. INPUT expects used prices to hold up well through this year and into early 1981, but pricing will erode as 3380s are delivered in reasonable volume (about mid-1981).
- Residual values for plug compatible manufacturers (e.g., STC, Memorex, CDC, etc.) are too volatile to predict with acceptable confidence levels. Trading is much less frequent. In general, used prices will be 60-80% of comparable IBM disk products; however, there have been instances where a PCM product has traded at a higher price than its IBM equivalent. This has occurred where an end user needed capacity very quickly and wanted to maintain vendor consistency while the used market supply was negligible.





**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer and Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Field Service Planning Information Program - Provides senior field service managers with basic information and data to support their planning and operational decisions.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$100,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1980 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2471 East Bayshore Road  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
Airwork House (4th Floor)  
35 Piccadilly  
London, W.1.  
England  
01-734-2156  
Telex 269776

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090



# INPUT

## PLANNING SERVICES FOR MANAGEMENT

RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1980

## PLANNING SERVICE FOR COMPUTER AND COMMUNICATIONS USERS

**OBJECTIVE:** To provide managers of large computer and communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.

**DESCRIPTION:** Client

U-RV9

AUTHOR

Tyler, Tim

TITLE

## Residual Value Forecasts

- Residual forecast
- peripheral
- Vendor of main DB/DBMS
- other EDP companies
- computer
- computer
- Impact impact development
- Conference location to client
- Consider as-needs
- Present client

g services each year:

v9 detailed five-year  
er mainframe and

the probable moves  
operating systems,  
mass storage, and

ains analyses and  
-term plans of  
ratio data.

th analyses of the  
rial, and personnel

held at a convenient  
times held according

search staff on an

ic presentations to

## h in computers,

ussions with client

Interviews with users,

et analysts.

Conclusions derived from the research are based on the judgement of INPUT's staff.

Professional staff supporting this program has 20 or more years of experience in data processing and communications, including senior management positions with major vendors and users.

For further information on this report or program, please call or write:

INPUT  
Park 80 Plaza West-1  
Saddle Brook, NJ -7662  
(201) 368-9471

or

INPUT  
2471 East Bayshore Road  
Suite 600  
Palo Alto, CA 94303  
(415) 493-1600

# INPUT

## PLANNING SERVICES FOR MANAGEMENT

### INPUT LIBRARY

RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND  
SOFTWARE-COMPATIBLE MAINFRAMES

DECEMBER 1980



RESIDUAL VALUE FORECASTS  
FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

ERRATA SHEET

Page 4, Paragraph 1, should read:

Demand for IBM 3033 processors has remained strong, while supply has been poor over the past several months. The result is continuing high values for this CPU. The 3033 has remained at or near the equivalent new price (82-86% of the list - the equivalent new price after warranty considerations). 3033 processors command a high premium in the European market (well over 100% of list), and thus brokers can make a tidy profit by exporting and reselling used 3033s to Europe.



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

## TABLE OF CONTENTS

	<u>Page</u>
I INTRODUCTION .....	I
II REVIEW OF RECENT USED-MARKET ACTIVITY .....	3
III REVIEW OF VENDOR ANNOUNCEMENTS (JUNE 1980 - NOVEMBER 1980) .....	5
A. IBM Announcements	6
B. Amdahl Announcements	9
C. National Advanced Systems (NAS) Announcements	12
IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE PROCESSORS .....	15



# RESIDUAL VALUE FORECASTS FOR LARGE IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

## LIST OF EXHIBITS

		<u>Page</u>
IV	-1 Projected Residual Values For IBM And Software- Compatible Mainframes	16
	-2 Projected Residual Values For the IBM 3033 Processor	17
	-3 Projected Residual Values For the IBM 3081 Processor	18
	-4 Projected Residual Values For The Amdalh 5860 Processor	19
	-5 Projected Residual Values For The NAS AS/9000 Processor	20

## I INTRODUCTION

- This Residual Value Forecast is produced as part of the Planning Service for Computer and Communications Users. Data contained in this series of reports are updated periodically. Key issues such as the future of IBM hardware and software and major product announcements, are the subjects of various other INPUT reports, including the "Vendor Watch" series, another part of the User Planning Service.
- In June 1980, INPUT published the fifth report in its continuing series on residual values of large IBM and IBM plug compatible CPUs. This report reviews significant events since June and updates the earlier residual value forecasts based on an analysis of recent developments.
- Forecasted residual values are provided for IBM, Amdahl and National Advanced Systems (NAS) processors. This report, for the first time, includes residual value forecasts for the 43XX CPU product series.
- Chapter II of this report reviews recent used-market activity in large IBM, Amdahl and NAS processors. The used computer industry does not publish records of transactions. Information in this chapter is obtained by interviewing people active in market trading.
- Chapter III reviews vendor activity since INPUT's June 1980 report. Major announcements are summarized, with INPUT commentary where appropriate. The past few months have been relatively active, culminating in IBM's new

CPU product line announcement. (The 3081 processor is the initiation of a strategy that will be discussed at length in a forthcoming Vendor Watch report.)

- Residual value projections for the various processors covered by this report are given in Chapter IV. The used computer industry, by convention, always lists used equipment as a percentage of the manufacturer's current list price. The projections in Chapter IV follow this convention. Readers are cautioned to consider further price changes when analyzing their own unique situations.

## II REVIEW OF RECENT USED-MARKET ACTIVITY

- The used market was unsettled in recent months as rumors and prognostications about the IBM "H" series were widely discussed. Points debated by industry watchers were not "if," but rather "when," and how severely would 303X values be affected.
- Values for IBM 370/158 and 370/168 mainframes dropped to about 15% of list in the early summer and drifted slowly downward from this level. Although these machines were relative bargains over the 303X alternatives, an unwarranted price differential continued because of an abundance of 158s and 168s in the marketplace.
- The IBM 3031 used-market values held up well during the summer and early fall - selling at around 70% of list price. Prices began to erode with the announcement of MVS operating system availability for the 4341 - clearly a signal that a more powerful 4341 version was imminent. The 4341 model group 2 came shortly thereafter - offering power equivalent to, or greater than, the 3031 at under \$500,000. Recent 3031 prices have slipped to the high 50s or low 60s as a percent of the "old" list price (i.e., prior to the November 12 price cut by IBM).
- The IBM 3032 has done poorly in the used market. The 370/168 and 3032 are viewed as essentially identical machines (INPUT's exact comment when the 3032 was announced in 1977), and used market prices for comparably configured machines are quite close. IBM took no action to differentiate the two

systems and indeed stopped building 3032s some time ago. The announcement of the first slowed-down version of the 3033 (the model N) clearly signaled IBM's abandonment of the 3032.

- Demand for IBM 3033 processors has remained strong, while supply has been poor over the past several months. The result is continuing high values for this CPU. The equivalent new price (82-86% of the list - the equivalent new price after warranty considerations). 3033 processors command a high premium in the European market (well over 100% of list), and thus brokers can make a tidy profit by exporting and reselling used 3033s to Europe.
- Amdahl processors have been doing relatively well in the used market - better than INPUT had predicted. This is apparently due directly to Amdahl's efforts to strengthen the second market for its systems. Amdahl has worked to improve relations with used-market brokers/dealers - partially because it has been taking "trade-ins" of V/5s and V/6s for the newer V/7 and V/8 systems. Such trade-ins generally take the form of assisting customers and brokers in the sale of displaced Amdahl processors. The V/5 and V/6 processors have been fluctuating about the mid-60s as a percent of list - while the few V/7s coming into the market have sold at near-equivalent new pricing.
- It remains difficult to obtain trend information on used values of National Advanced Systems (NAS) processors. Although several hundred systems have been placed, a secondary market with frequent trading has not yet come into existence. In recent advertising, NAS has said that its product family "boasts higher residual values over time than even IBM." One assumes there is a basis for such a claim. Customer satisfaction ratings give both NAS and Amdahl high marks - and this may be the basis for the demonstrated residual value optimism.



### III REVIEW OF VENDOR ANNOUNCEMENTS (JUNE 1980 - NOVEMBER 1980)

- Highlights for the period under review - June-November of 1980 - were:
  - IBM finally introducing a new evolutionary product generation endorsing the multiprocessor concept and featuring new chip-packaging technology and a substantial advance in channel design and integration.
  - The collapse of the Amdahl-Storage Technology Corporation merger plans, as well as Amdahl's response to the IBM new product announcement with its new generation 580 series of processors.
  - NAS "introducing" the AS/9000 processor - a Hitachi-built CPU based on the M200H (introduced by Hitachi in 1978) - and also an adoption by NAS of the "multimodel" CPU concept. This clever idea, first brought to the market by Amdahl with the A, B and now C versions of the base V/7 machine, was then copied by IBM with the N and S versions of the 3033. NAS, not to be left out, brought forth in this period N and E models of the AS/5000 mainframe.
- Significant announcements since June, grouped by vendor, are detailed in the remainder of this chapter.



## A. IBM ANNOUNCEMENTS

- June 1980:

- IBM increased rental and lease prices for 43XX, 303X and 370 series mainframes by 5%. Purchase prices were not raised, to maintain a competitive position vis-a-vis software-compatible vendors, and to further encourage purchase conversion. This round of price increases was similar in nature to June 1979 and December 1979 IBM price hikes. Such increases are designed to meet profitability objectives in times of relatively high inflation. If current inflation rates continue, such pricing actions are inevitable.
- In a separate action, IBM reduced the price of the 3033 attached processor (3042-1) by 10% when a newer model (3042-2) was announced. The 3042-2 has its own set of channels (six are standard, expandable to twelve). The announced price of \$1.225 million was subsequently (November 1980) reduced by 8%. A 3033 with the 3042-2 thus permits up to 28 channels, of which 10 can support a three-megabit data rate. More importantly, this new AP model now permits operating the two CPUs as separate entities - with main memory allocation handled by the 3038 CPU connector module.
- The marketing of 370/158 and 370/168 processors was discontinued effective September 15, 1980 - with model upgrades and CPU features on an "as-available" basis. The used market thus becomes the primary source for this equipment, which it really had been for some time.

- July 1980:

- IBM announced it would support the MVS operating system (the primary system control program for large processors) on the 4341-1 CPU. This clearly signaled an upward convergence towards the 3033 product series.

- September 1980:
  - The 4341 Model Group 2 was added to the growing 43XX series. Principal characteristics are:
    - Operating speed about 1.8 times faster than the 4341-1, and thus above the 370/158 and 3031 mainframes.
    - Ability to use the MVS operating system.
    - Main memory in 2-, 4- or 8-megabyte increments.
    - Conversion of a 4341-1 to a 4341-2 can be done on-site in 15-23 hours.
    - Six channels, with two capable of supporting a three-megabit data rate.
  - This 43XX model was widely predicted in the trade press months before announcement (and by INPUT two years ago).
- October 1980:
  - The number of channels attachable to the 3033N was expanded to 16 - making it identical in this respect to its 3033 big brother. With a previous announcement expanding maximum memory size to 16 megabytes, there is now little functional difference between the 3033N and the 3033.
- November 1980:
  - The new generation of IBM large processors was introduced on November 12. The first product was designated the 3081. At the same time, IBM also brought forth:

- New releases of the MVS operating system.
  - A further (beyond the 3033N) slowed-down version of the 3033, labeled the 3033 model S.
  - A "free" powerboost of 5-14% for the 3033N.
  - Price reductions for 303X processors.
- INPUT is presently analyzing the 3081 product announcement, and an in-depth review, interpretation and forecast of the ramifications of this announcement will be published as a Vendor Watch report in the near future. Some highlights about the announcement per se are:
- New logic technology providing higher chip densities, improved cooling techniques (still employing internal chilled water) and better component packaging.
  - Dual-processor architecture (but lacking the ability for independent processor operation available with 3033 MP or 3033/3042 AP architecture).
  - Twice the power of the 3033 at about a 30% higher price. The 3081 has a machine cycle time less than half of the 3033's (26 usec versus 57 usec) and employs two processors - thus one would expect considerably more than twice the 3033 uniprocessor performance. IBM attributes this to trading off performance for design simplification in order to achieve improved reliability.
  - Sixteen, 24, or 32 megabytes of shared central storage memory.
  - Sixteen or 24 channels, all supporting data streaming (i.e. 3 megabit data rate) for a maximum data rate of 72 megabits/-

second. This jump in aggregate data rate required an entire redesign of the channel architecture.

- . First availability in fourth quarter, 1981.
- The new 3033 Model S is attributed to have about twice the performance of the 3031 for 60% additional cost. The Model S can be upgraded in place, to the Model N or the 3033. It has six channels and can support 4 or 8 megabytes of memory. First availability is January 1981 (upgrade to Model N available by December 1981).
- The price reductions for 303X processors were close to INPUT's projections made in the previous mainframe residual value report. (The June report projected 10-20% price reductions before the end of 1980.) The prices for 303X minimum configurations changed as follows:

Processor Model	Memory in Megabytes	Number of Channels	Old Price (\$ thousand)	New Price (\$ thousand)	Percent Decline
3031	2	6	\$ 800	\$ 622	22%
3032	2	6	1,520	1,190	22
3033N	4	6	1,800	1,750	3
3033	4	12	2,870	2,425	16

## B. AMDAHL ANNOUNCEMENTS

- July 1980:
  - The good news for Amdahl in July was the sharply higher second quarter revenues and profits over the previous year's. The outright purchase to lease ratio shifted (from 60%:40% to 70%:30%) - a trend that continued into the third quarter, where the ratio climbed to 80%:20%.



- The bad news was the collapse of the merger negotiations with Storage Technology Corporation. Apparently, Fujitsu (the major Amdahl shareholder, with about 28% ownership) and the supplier to Amdahl of components and subassemblies, could not reach resolution on certain issues; e.g., exclusive use of Fujitsu-supplied circuits, technology exchange rights, etc.

- August 1980:

- Amdahl announced support for the data-streaming feature (i.e., three megabit/second data rate on channels). This capability is available on all Amdahl processors (one channel per four-channel group for V/5 and V/6, two channels per four-channel group for V/7 and V/8).
- Also in August, Gene Amdahl, founder of the company bearing his name, resigned to start a new company. Because he had largely withdrawn from active management of Amdahl, the immediate impact on the company should be minimal. The longer-term impact may be substantial - if he is successful in bringing an advanced large-scale processor into the market in the next three to four years. Given Storage Technology Corporation's recent announcement of plans to also develop a large-scale processor, an Amdahl (Gene) and STC merger may yet take place.

- September 1980:

- Expanded channel attachability to V/7 and V/8 mainframes was announced. These CPUs will be able to attach 24, 28 or 32 channels - a mid-life booster providing a temporary technical superiority over competitors. Amdahl, in its move towards greater software independence, also announced several new enhancements in this area, including support for the popular UNIX timesharing system. A further announcement was the capability, via a single operator command, to restore a 470 V/7B to a full V/7 (a 50% power increase). As with previous

accelerator unveilings, the use of the feature is charged at an hourly rate, based on actual usage (in this case, \$300 per hour).

- November 1980:

- Within a few days of the IBM 3081 and 3033-S product announcements, Amdahl responded with the 580 series (the model 5860 uniprocessor with first delivery in April 1982, and the model 5880 dual-processor with first delivery in early 1983) and the 470 V/7C. Amdahl also responded to IBM 303X price cuts by reducing all 470 mainframe prices 17%.
- The Amdahl 5860 is similar in concept to the IBM 3081 in that both represent fundamental building blocks for future evolution, both employ new logic design, cooling techniques and major channel redesign, and both have significant capabilities inherent in the machine that will be revealed in the future. Significant features of the 5860 revealed in November include:
  - . Twice the V/8 in processing power (about 2.6 times a 3033). This gain was obtained by reducing the machine cycles required to execute an instruction from two to one.
  - . Use of microcode, distributed to the functional units where used. Amdahl had not used microcode prior to this product because memory speeds produced overall degradation in performance. The availability of seven-nanosecond RAM devices and an architecture co-mingling logic and memory chip carriers on the same board allowed a move to microcode use (obviously important in maintaining compatibility with future IBM developments).
  - . Up to 32 megabytes of main memory.



- Up to 34 channels, all of which can support data streaming (three megabit/sec data rate). The channels were in fact announced with a six megabit/sec data rate.
- A very compact and clean processor design, with the CPU and channels implemented on eight multiple chip carriers housed in a 5.6 cubic-foot stack - with air cooling.
- The 470/7C processor is now identified as the Amdahl entry-level system (V/5s or V/6s have not been manufactured for some time). Entry-level price is \$1.05 million (four megabytes of memory and eight channels). Maximum memory size is eight megabytes. An accelerator option is available to upgrade the processor to the V/7B level. First customer shipment is scheduled for the third quarter of 1981. Rated performance by Amdahl is about 50% of the V/7.

### C. NATIONAL ADVANCED SYSTEMS (NAS) ANNOUNCEMENTS

- August 1980:
  - NAS announced that the AS/5000 and AS/7000 mainframes would support data streaming and MVS enhancements - and thus remain fully compatible with IBM.
- September 1980:
  - Two slowed-down versions of the AS/5000 were introduced to compete against IBM's 4341 processors. The AS/5000N (about 0.9 MIPS) and the AS/5000E (about 1.1 MIPS) will run the IBM 4300 DOS/VSE-associated instruction set in native mode, as well as the VM, OS/VSI and MVS operating systems. The new processors are currently available;

however, the 4300 instruction set DOS/VSE option will not be available until the third quarter of 1981.

- NAS also disclosed in September that it would market a version of Hitachi's M200-H processor on a nonexclusive basis. Called the AS/9000, the product was scheduled for first delivery in November. This short lead time can be attributed to the fact that the processor characteristics were well known - indeed Intel had announced in July of last year the AS/8 model 7034, based upon the same M200-H CPU. The announcement provided the following product characteristics:
  - . About twice the performance of the IBM 3033. (Entry-level price for the AS/9000 is \$3.95 million.)
  - . Eight to 16 megabytes of main memory in two-megabyte increments.
  - . 64K cache buffer storage with 40 nanosecond machine cycle time.
  - . Twelve standard channels, expandable to 16.
  - . Air cooling.
- An interesting aspect of this product is that two-, three- and four-processor complexes have been announced by Hitachi in Japan. This appears to be a reasonable future growth path when IBM announces multiprocessor versions (greater than two) of the 3081 supported by MVS.



#### IV PROJECTED RESIDUAL VALUES FOR LARGE IBM AND SOFTWARE-COMPATIBLE PROCESSORS

- INPUT projects residual values based on:
  - Anticipated actions by IBM.
  - Responding strategies by the plug compatible mainframe manufacturers.
  - Analysis of technology development and how it affects the changing role of the large CPU in evolving communications/data base networks.
  - Analysis of other variables affecting residual values, as described in the Appendices of previous reports (see Residual Value reports dated April 1978, October 1978, April 1979 and October 1979).
- The number of processors for which residual values are projected has expanded to the point where graphs for each one would create an excessively bulky report. Therefore a table format for projections has been adopted as the most effective means of presenting the future residual values shown in Exhibit IV-1.
- As a supplement to this table, graphs have been prepared for those mainframes judged to be of greatest interest to our subscribers. Thus Exhibits IV-2 through IV-5 provide graphical projections for the IBM 3033 and 3081, the Amdahl 5860 and the NAS AS/9000 CPUs. The 3033 was selected because of

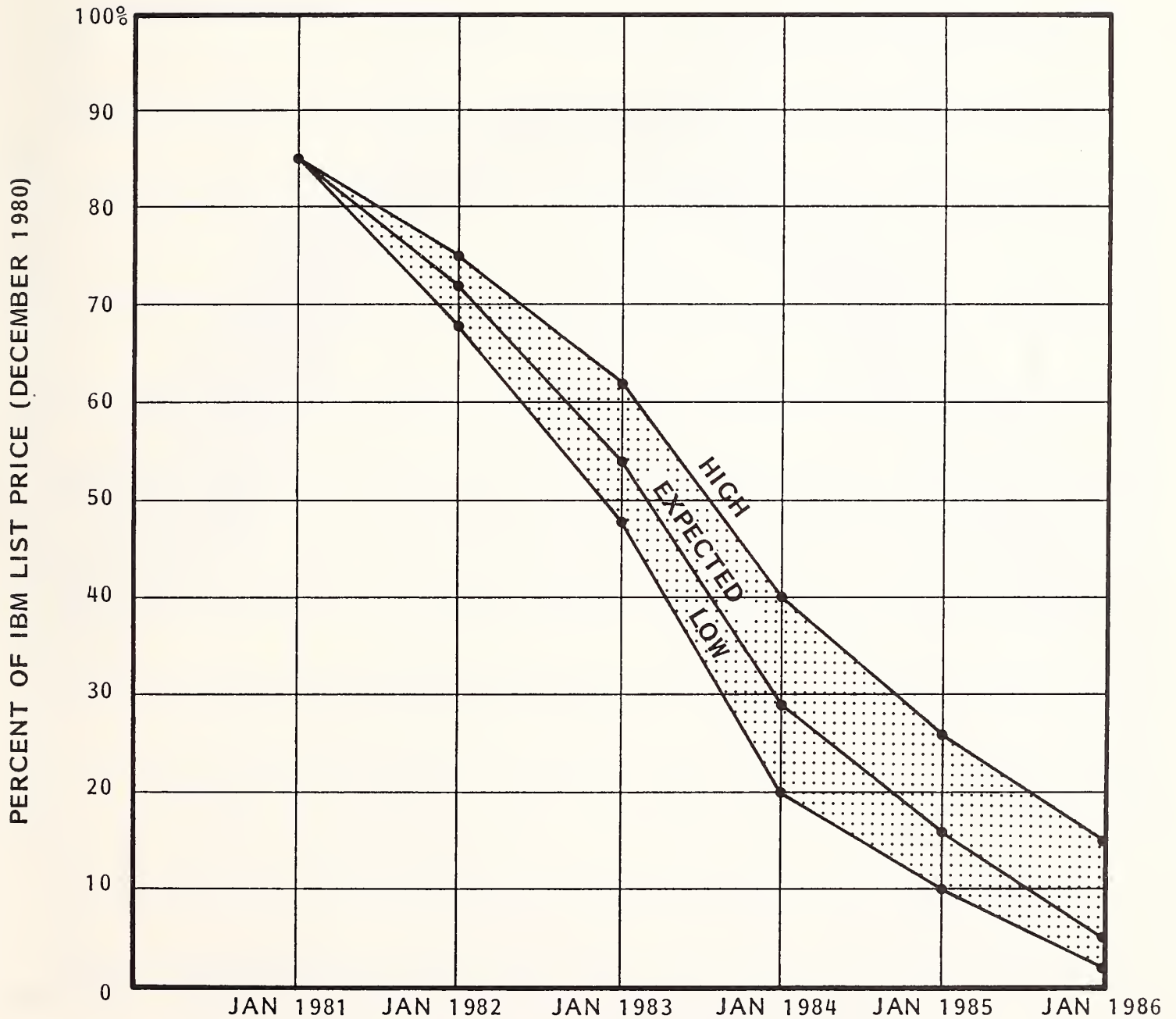
## EXHIBIT IV-1

PROJECTED RESIDUAL VALUES FOR  
IBM AND SOFTWARE-COMPATIBLE MAINFRAMES

VENDOR	PROCESSOR MODEL	PROJECTED RESIDUAL VALUE AS PERCENT OF VENDOR LIST PRICE (DEC. 1980)					
		JAN. 1981	JAN. 1982	JAN. 1983	JAN. 1984	JAN. 1985	JAN. 1986
IBM	370/158-3	14%	10%	6%	3%	2%	1%
	370/168-3	12	9	5	3	2	1
IBM	3031	66	45	28	18	9	4
	3032	47	34	23	13	6	3
	3033-S	-	84	63	34	21	9
	3033-N	85	74	57	31	19	8
	3033	85	72	54	29	16	5
IBM	4331-1	-	84	74	61	43	19
	4331-2	-	86	77	64	44	21
	4341-1	-	85	78	62	40	17
	4341-2	-	90	83	64	42	19
IBM	3081	-	90	88	80	57	40
AMDAHL	470 V/5	67	45	29	17	9	2
	470 V/6-II	63	40	26	15	8	1
AMDAHL	470 V/7 SERIES	85	76	54	28	15	4
	470 V/8	-	79	56	30	17	6
AMDAHL	5860	-	-	85	78	56	40
	5880	-	-	-	85	63	44
NAS	AS/5000	58	43	27	17	8	3
	AS/5000 N,E	-	67	46	27	14	6
	AS/7000	60	39	23	13	6	2
NAS	AS/9000	-	85	81	73	52	35

## EXHIBIT IV-2

### PROJECTED RESIDUAL VALUES FOR THE IBM 3033 PROCESSOR



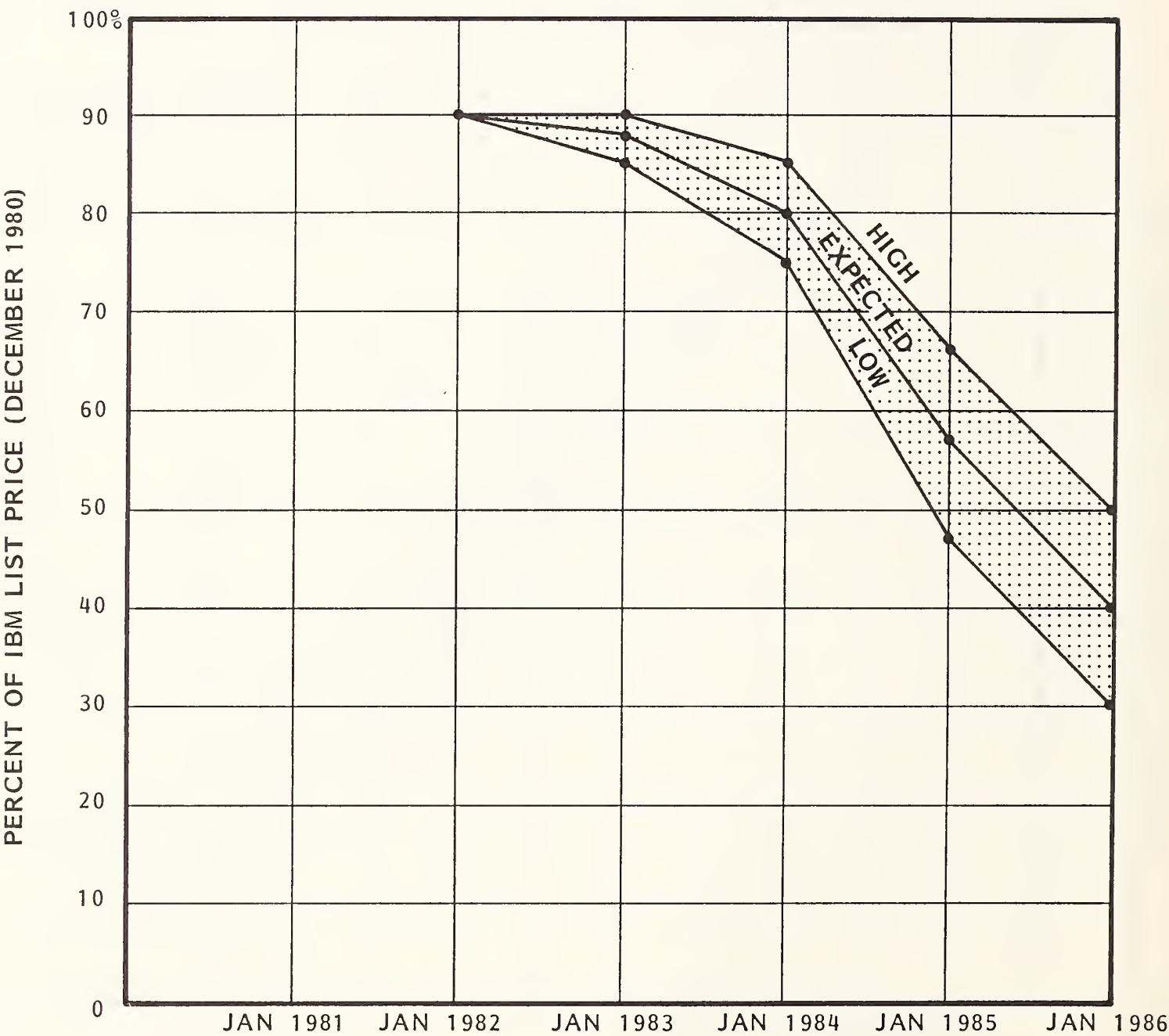
PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1981	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	75%	62%	40%	26%	15%
EXPECTED	85%	72	54	29	16	5
LOW	-	68	48	30	10	1



EXHIBIT IV-3

PROJECTED RESIDUAL VALUES FOR THE IBM 3081 PROCESSOR

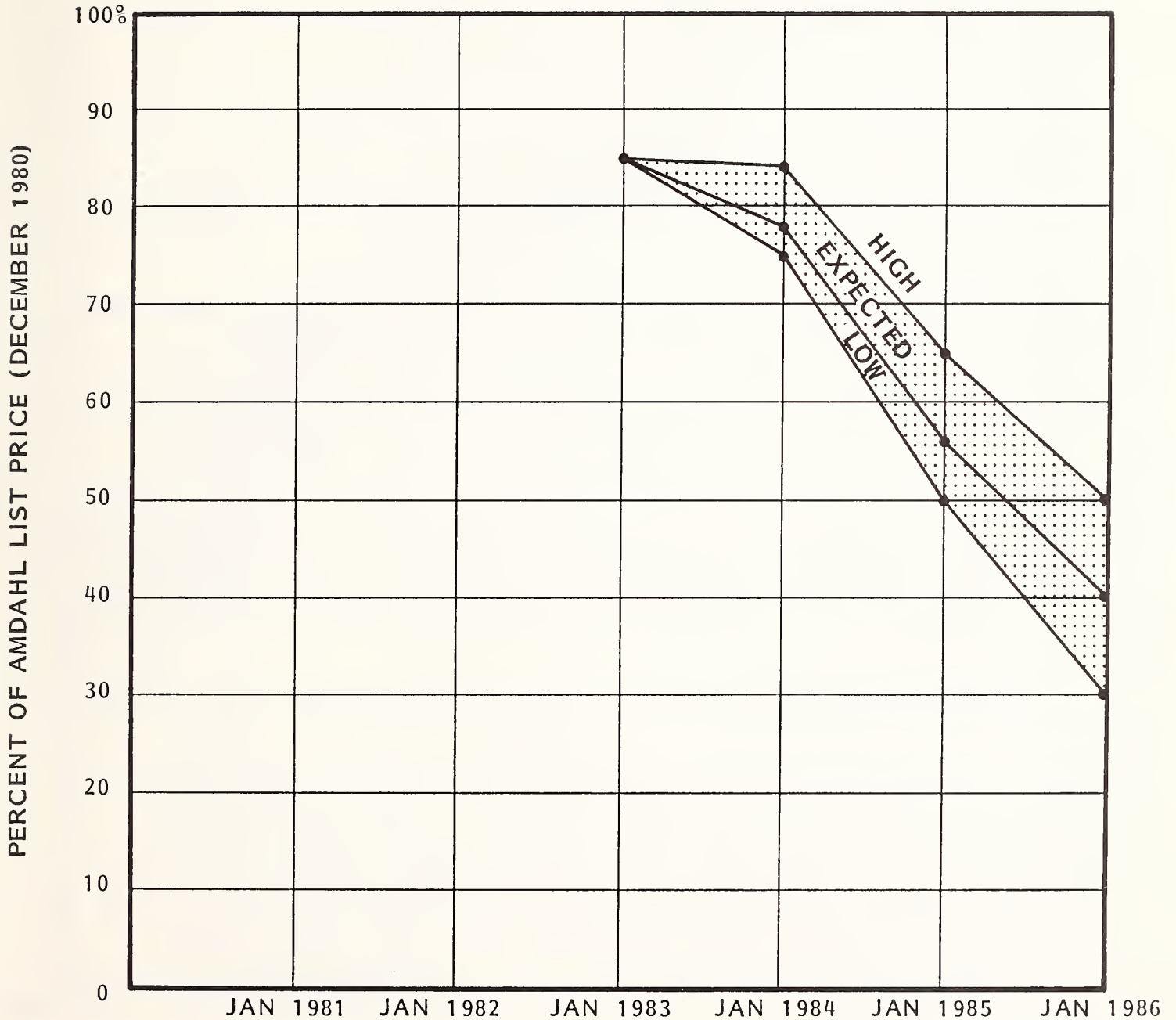


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	90%	85%	66%	50%
EXPECTED	90%	88	80	57	40
LOW	-	85	75	47	30

# EXHIBIT IV-4

## PROJECTED RESIDUAL VALUES FOR THE AMDAHL 5860 PROCESSOR

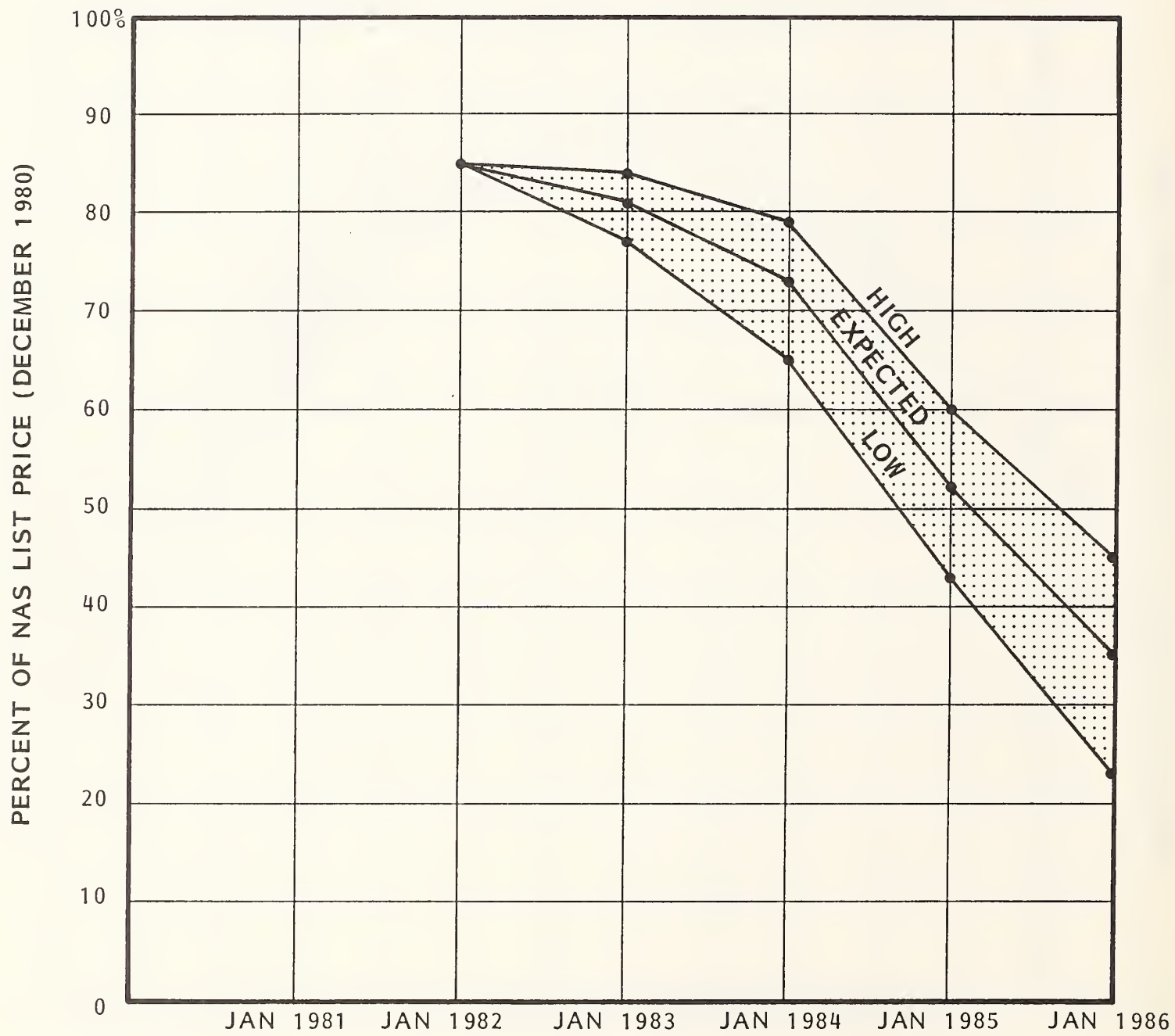


PROJECTED VALUES

PROJECTED VALUES RANGE	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	84%	65%	50%
EXPECTED	85%	78	56	40
LOW	-	75	50	30

EXHIBIT IV-5

PROJECTED RESIDUAL VALUES FOR THE NAS AS/9000 PROCESSOR



PROJECTED VALUES					
PROJECTED VALUES RANGE	JAN 1982	JAN 1983	JAN 1984	JAN 1985	JAN 1986
HIGH	-	84%	79%	60%	45%
EXPECTED	85%	81	73	52	35
LOW	-	77	65	43	23

the numerous inquiries received concerning future values of this product, and the others because they represent new-generation mainframes for IBM, Amdahl and National Advanced Systems (NAS).

- Projections for the 43XX processor series have been included for the first time. INPUT anticipates a convergence between the 43XX product group and the 3081 product group that will form both an upward-compatible growth path for centralized computing approaches and an alternative for distributed processing under centralized guidance. INPUT's analysis of future IBM strategies in this area will be distributed as a Vendor Watch Report in the near future.
- The IBM 370/158 and 370/168 processors remain in plentiful supply, a situation that is expected to continue over the remaining life of these machines. Values can be expected to decline slowly as the 4341-2 and 3033 model S displace 158s and 168s and add to the market supply.
- The relative bulk and higher maintenance and electric power costs of 158 and 168 mainframes are becoming more important factors when comparing these 370 systems to newer-technology alternatives.
- The IBM 3031 and 3032 processors have essentially been abandoned by IBM. The 3031 is an air-cooled machine; however, the advantage of air-cooling will come under attack by IBM in defense of its decision to utilize internal chilled-water cooling. On-the-floor chillers are now available as an alternative to expensive piping systems - a fact IBM readily points out. The rapid decline of the 3031 and 3032 was predicted in INPUT's previous mainframe residual report, and current projections reflect only minor refinements to those predictions.
- The IBM 3033, on the other hand, was given a strong endorsement via the new attached-processor alternative, a second slowed-down model with upward growth mobility, and (after the November price cut) competitive pricing with the newer 3081. IBM needs the revenue stream from the 3033 series until the



3081 is in volume delivery. Volume deliveries of 3081s will place large numbers of 3033s in the used market, driving prices down. The sharp decline in 3033 values (shown earlier in Exhibit IV-2) in the late 1982 through 1983 timeframe anticipates this action. The 3033 "mid-life kicker" was more aggressive, however, than INPUT projected, and thus 3033 values have been increased over previous (June 1980) forecasts.

- The decline in value for the 3081 (shown earlier in Exhibit IV-3) commencing in early 1984 stems not from expected market supply versus demand conditions, but rather from projected price reductions by IBM to maintain a competitive position. Ready availability of Amdahl and NAS competitive products, and perhaps new competition from Gene Amdahl, STC and/or the Japanese, is expected to produce aggressive price reductions on "new generation" products.
- Although INPUT does not expect a new high-end processor generation to be introduced during the period of this projection (i.e., through 1985), this is not true for the lower-end 43XX product line. Although it is too early to predict the nature of such a follow-on series, IBM will begin to "obsolete" the 43XX product line in the 1984-1985 timeframe. The decline in 43XX values shown in Exhibit I thus reflects the rumor/appearance of a new product generation and selective price reductions in concert with the previously discussed 3081 pricing actions.
- Values for Amdahl processors have been increased (over the June report projections) on the assumption that efforts by Amdahl to assist in secondary market transactions will continue. A more positive attitude by used-market broker/dealers towards handling Amdahl equipment is evident and should increase the marketability of such equipment. The installed base of satisfied Amdahl customers continues to expand and likewise helps in the acceptability and market size for used Amdahl processors.
- Exhibit IV-4 graphs the projected values of the recently announced Amdahl 5860 processor (the initial entry in the 580 CPU series). The drop in values in the 1984-1985 period are due primarily to expected price reductions -

reactions to IBM price cutting in the 3081 product group. A similar pattern can be seen for the NAS AS/9000 processor (shown earlier in Exhibit IV-5).

- The projections in this report assume that IBM's near-term strategy is to keep the 3033 and its spin-offs (models N and S) as a mainline product (i.e., aggressively marketed by its sales staff) through 1981 and into 1982. The 3033 product group will be phased out when appropriate by upward expansion of the 43XX series (perhaps 4351 models 1 and 2) and downward movement of the 3081 (perhaps N and S slowed-down versions similar to the 3033 example). Revenue enhancement in the software, services and local processing (office automation products) areas will permit substantive price reductions on large mainframes in the 1984-1985 period without sacrificing long-term financial objectives.





**SUBSCRIPTION PROGRAMS:** Designed for clients with a continuing need for information about a range of subjects in a given area. All subscription programs are fixed fee and run on a calendar year basis:

- Planning Service for Computer and Communications Users - Provides managers of large computer/communications facilities with timely and accurate information on developments which affect today's decisions and plans for the future.
- Field Service Planning Information Program - Provides senior field service managers with basic information and data to support their planning and operational decisions.
- Computer Services Market Analysis Service - Provides market forecasts and business information to software and processing services companies to support planning and product decisions.
- Computer Services Company Analysis and Monitoring Program - Provides immediate access to detailed information on over 2,000 companies offering software and processing services in the U.S. and Europe.

**MULTICLIENT STUDIES:** Research shared by a group of sponsors on topics for which there is a need for in-depth "one-time" information. A multiclient study typically has a budget of over \$100,000, yet the cost to an individual client is usually less than \$10,000. Recent studies specified by clients include:

- Maintenance Requirements For The Information Processing Industry
- Value Added Network Services
- IBM Series/I Analysis

**CUSTOM RESEARCH:** Custom studies are proprietary to a client. Fees typically range from \$10,000 to over \$100,000 and are a function of the extent of the research work. Examples of recent assignments include:

- Survey Fortune 500/50 companies to determine plans for distributed data processing.
- Compare the internal charges for EDP services in a large company to those of commercially available services.
- Determine the market potential for an associative Relational Data Base Management System Processor.
- Conduct the 1980 ADAPSO Survey of the Computer Services Industry.
- Analyze the opportunities and problems associated with packaging terminals and/or minicomputers with remote computing services.

## ABOUT INPUT

### THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client management in making informed decisions. Continuing services are provided to users and vendors of computers, communications, and office products and services.

The company carries out continuous and in-depth research. Working closely with clients on important issues, INPUT's staff members analyze and interpret the research data, then develop recommendations and innovative ideas to meet clients' needs. Clients receive reports, presentations, access to data on which analyses are based, and continuous consulting.

Many of INPUT's professional staff members have nearly 20 years experience in their areas of specialization. Most have held senior management positions in operations, marketing, or planning. This expertise enables INPUT to supply practical solutions to complex business problems.

Formed in 1974, INPUT has become a leading international consulting firm. Clients include over 100 of the world's largest and most technically advanced companies.

### UNITED STATES, West Coast

2471 East Bayshore Road  
Suite 600  
Palo Alto, California 94303  
(415) 493-1600  
Telex 171407

### UNITED STATES, East Coast

Park 80 Plaza West-1  
Saddle Brook, New Jersey 07662  
(201) 368-9471

### UNITED KINGDOM

INPUT Europe  
Airwork House (4th Floor)  
35 Piccadilly  
London, W.1.  
England  
01-734-2156  
Telex 269776

### AUSTRALIA

Infocom Australia  
Highland Centre, 7-9 Merriwa Street  
P.O. Box 110, Gordon N.S.W. 2072  
(02) 498-8199  
Telex AA 24434

### ITALY

PGP Sistema SRL  
20127 Milano  
Via Soperga 36  
Italy  
Milan 284-2850

### JAPAN

Overseas Data Service Company, Ltd.  
Shugetsu Building, No. 12-7 Kita Aoyama  
3-Chome Minato-Ku  
Tokyo, 107  
Japan  
(03) 400-7090